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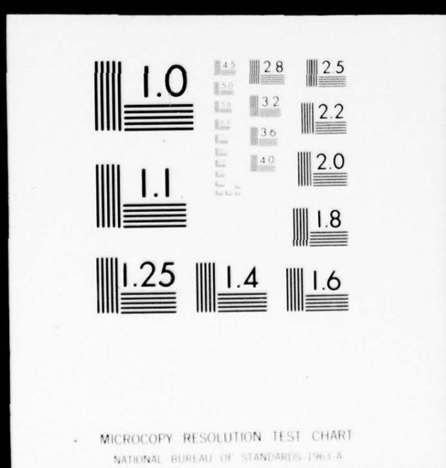

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RESEARCH AND DEVELOPMENT TECHNICAL REPORT
ECOM-DR-77-2

BOUNDARY LAYER DUST OCCURRENCE
III
ATMOSPHERIC DUST OVER RUSSIA

DATA REPORT
By

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MAY 1977

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This is the third in a series of reports designed to provide a guide to the occurrence of atmospheric dust over selected geographical areas. Tabularized data on the diurnal variation of occurrence by month and on the duration factor for selected time periods throughout a year for blowing dust (visibility less than 11 km) and of dust storms (visibility less than 1 km) are presented for 85 stations in Siberia, 75 stations in Soviet Central Asia, and 54 stations in the Union of Soviet Socialist Republics. Previously published climatological data

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20. Abstract (cont)

on the occurrence of dust over the three geographical subdivisions are summarized in Appendix A. Where translations of these articles into English are known to exist, they are included in Appendix B.

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PREFACE

The authors thank 1LT James Fowler for his assistance in compiling the data and providing information on current geopolitical aspects of the area of concern, SGT Robert Carroll, Jr., for his assistance in compiling these data, and Wendell Watkins for his helpful suggestions during the preparation of this report.

CONTENTS

LIST OF FIGURES AND TABLES

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INTRODUCTION

Airborne dust (and sand) is one of the most damaging environmental elements. A dusty atmosphere may contribute to the deterioration of materials and can present serious problems in the operation and maintenance of mechanical and electrical equipment. Moreover, atmospheric dust is a limiting factor in the propagation of electromagnetic energy through the atmosphere.

The primary purpose of this series of reports is to provide a guide to the occurrence of atmospheric dust over selected geographical areas. Part I presented data from two stations in the White Sands Missile Range, New Mexico, area [1]. Part II summarized data on the occurrence of dust at 135 stations in the Middle East, Near East, and North Africa [2]. The purpose of Part III is to present similar data for the USSR.

The main body of Part III consists of tabularized data on: (1) the diurnal variation of the likelihood of restrictions to visibility by airborne dust by month, and (2) duration factors for greater than or equal to 1, 3, 6, 9, 12, and 24 hours for 85 stations in Siberia, 75 stations in Soviet Central Asia, and 54 stations in the Union of Soviet Socialist Republics. The visibility restrictions are divided into two categories: (1) visibility less than 11 km (blowing dust) and (2) visibility less than 1 km (dust storm). Previously published climatological data on the occurrence of dust in the Ukraine, the Transvolga, Siberia, the Altai region, and Kazakhstan are summarized in Appendix A. Where English language translations of these articles are known to exist, they are included in Appendix B.

DEFINITIONS

BLOWING DUST: Dust raised by the wind to moderate heights above the ground which restricts horizontal visibility to less than 7 miles* (11 km).

DUST STORM (including severe): The same as blowing dust, except visibility is reduced to less than 5/8 mile* (1 km).

NUMBER (N) OF DUST OCCURRENCES: The arithmetic mean of the annual number of occurrences of dust equal to or greater than 1 hour duration.

BACKGROUND

Questions arise on the likelihood of blowing dust or dust storms occurring at a specific time of day and/or month of the year and on the likelihood of their lasting for a specified period of time. In response

*Federal Meteorological Handbook No. 1, Surface Observations, Change 2, 1 Jan 72

to a request from the Atmospheric Sciences Laboratory (ASL), White Sands Missile Range, NM, the United States Air Force, Air Weather Service (Environmental Technical Applications Center) tailored an analysis of available magnetic tape records of weather observations from 650 worldwide stations to answer these questions. The weather observations from these 650 stations are three hourly, i.e., a single observation taken every 3 hours. Thus, a given dust condition lasting 3 hours or more would be recorded at least once, whereas dust conditions of shorter duration may or may not be recorded at all.

GEOGRAPHICAL COVERAGE

As stated, Part III covers 214 stations in Siberia, Soviet Central Asia, and the Union of Soviet Socialist Republics. The locations of these stations are shown in Figures 1 through 5. Tables 1 through 3 include the World Meteorological Organization (WMO) number, latitude, longitude, and elevation for each of the 214 stations. Stations having no occurrences of dust at either the <11 km or <1 km visibility level (N/A) were included to emphasize that the data from these stations had been examined for blowing dust and dust storms. For a station to be represented in this report, the available period of record had to be 5 *years or more*.

DUST PATTERNS

A number of articles on the occurrence of atmospheric dust over the USSR have been published. Often these articles contain map charts of climatological data on the average number of days (per year, per season), maximum number of days per year, and/or average duration of visibilities reduced by atmospheric dust. These geographical area patterns provide convenient summaries of data from original single station reports such as those contained herein. Table 4 is a quick reference to the location of these map charts in this report.

OCCURRENCE

The data on the variability of the occurrence of dust at each of the 214 stations are contained in Tables 5 through 218. Each table consists of two parts. One part gives the diurnal variation of the occurrence of each of two visibility classes (less than 1 km and less than 11 km) by month. The percentages represent averages for the period of record and are based on data actually taken at the specified hours. The second part contains the duration factor, in decimal percent, of visibilities reduced to less than 1 km and less than 11 km for periods greater than or equal to 1, 3, 6, 9, 12, and 24 hours.

To find the percent likelihood of a given visibility condition lasting for a certain period of time at a specified hour and month at a specific site, multiply the duration factor by the occurrence. For example, the

likelihood of the visibility being less than 11 km for at least 6 hours beginning at 1600 in May at Krasnovodsk, Turkmen SCA (Table 110) is approximately 3 percent (0.55 x 6 percent).

SUMMARY

For the geographical area of concern, the patterns of occurrences are similar with the highest frequency of occurrence being centered in the late afternoon in spring and early summer.

The period of record is not identical for all stations; therefore, caution is urged where comparisons between or among stations is required.

LITERATURE CITED

1. Hinds, B. D., R. F. Kimberlin III, and G. B. Hoidale, 1975, "Boundary Layer Dust Occurrence. I. Atmospheric Dust over the White Sands Missile Range, New Mexico, Area," ECOM-DR-75-2, Atmospheric Sciences Laboratory, US Army Electronics Command, White Sands Missile Range, NM, 67 pp. (AD A010 335)

2. Hinds, B. D. and G. B. Hoidale, 1975, "Boundary Layer Dust Occurrence. II. Atmospheric Dust over Middle East, Near East, and North Africa," ECOM-DR-75-4, Atmospheric Sciences Laboratory, US Army Electronics Command, White Sands Missile Range, NM, 188 pp. (AD A022 637)

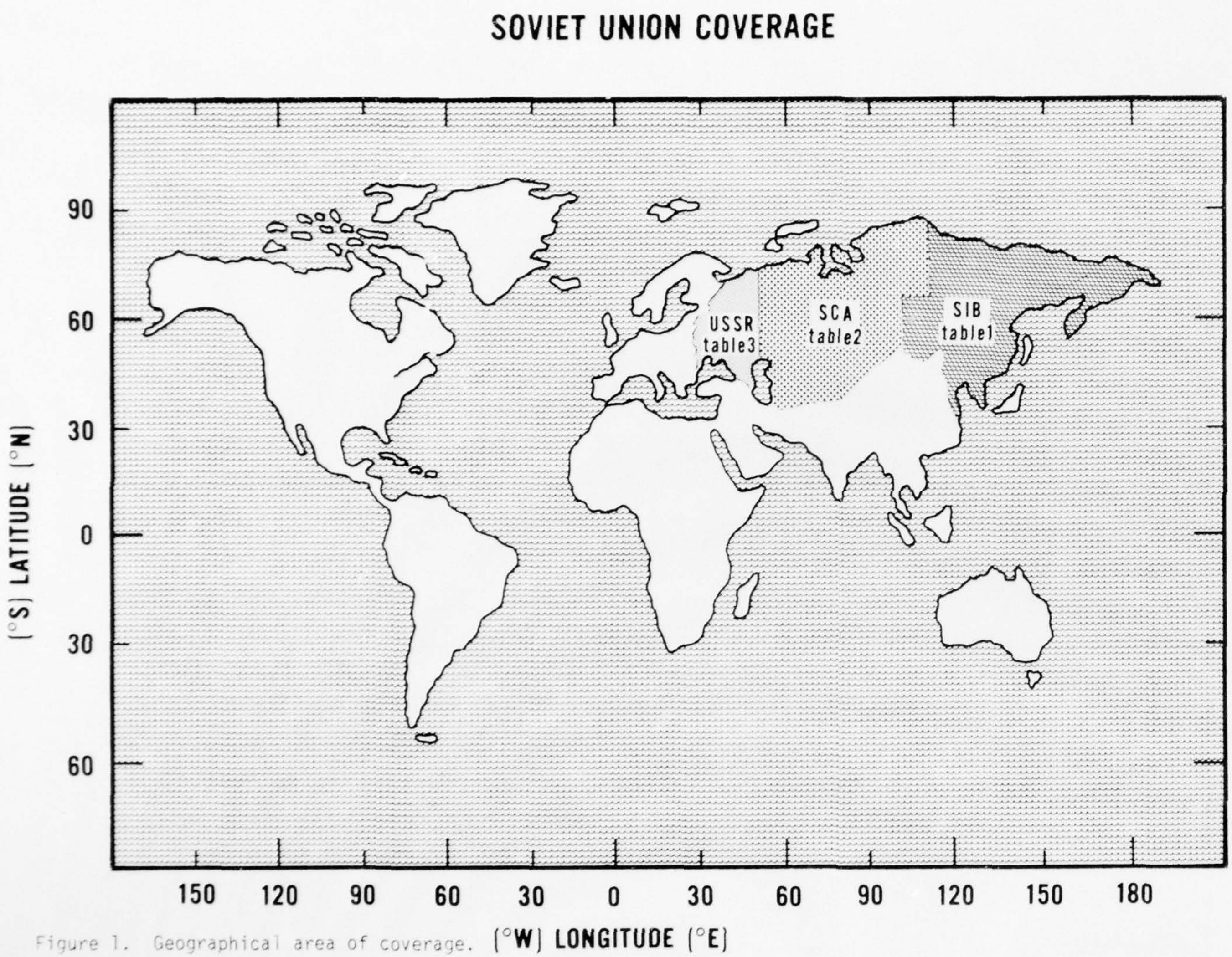

Figure 1. Geographical area of coverage.

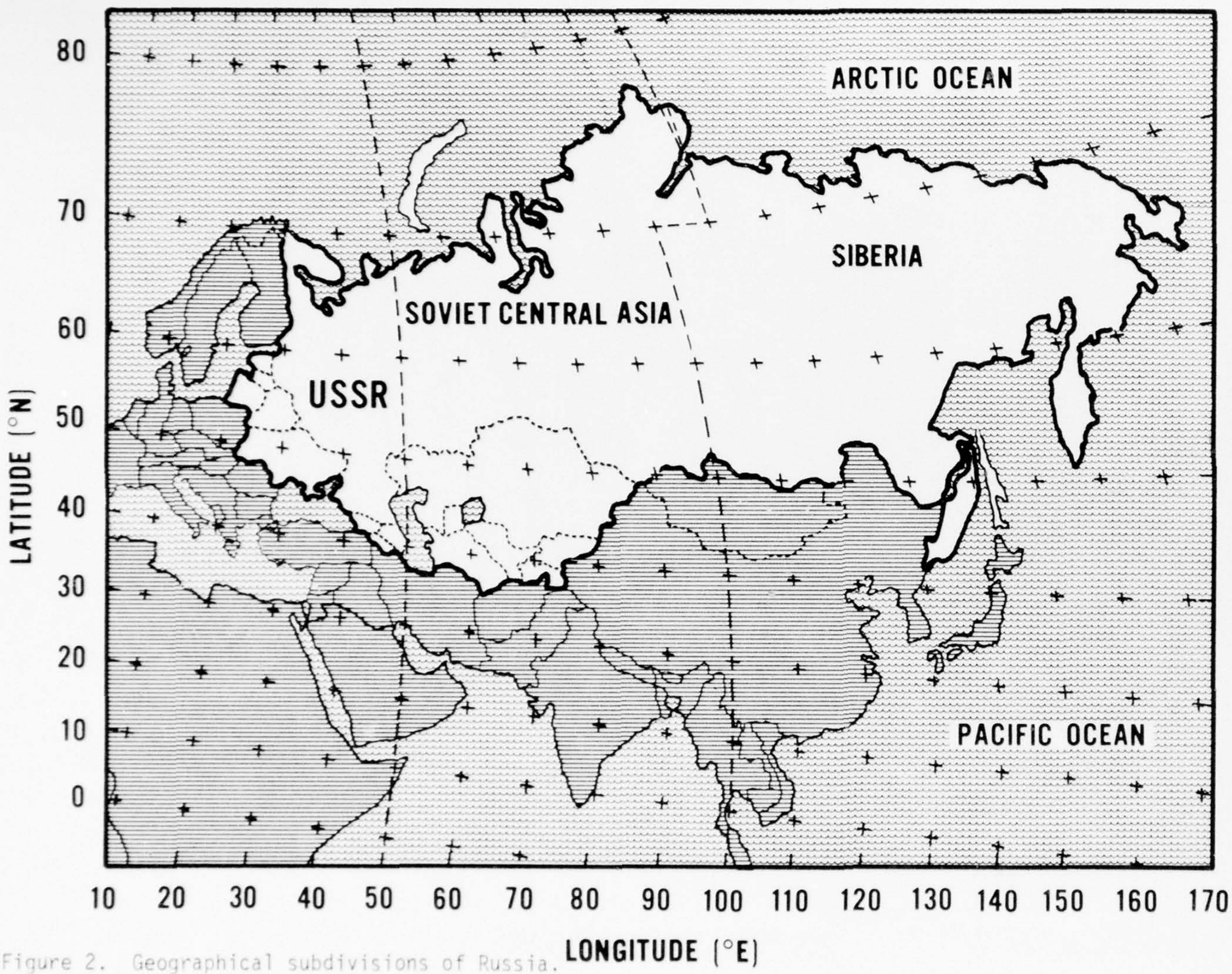

Figure 2. Geographical subdivisions of Russia.

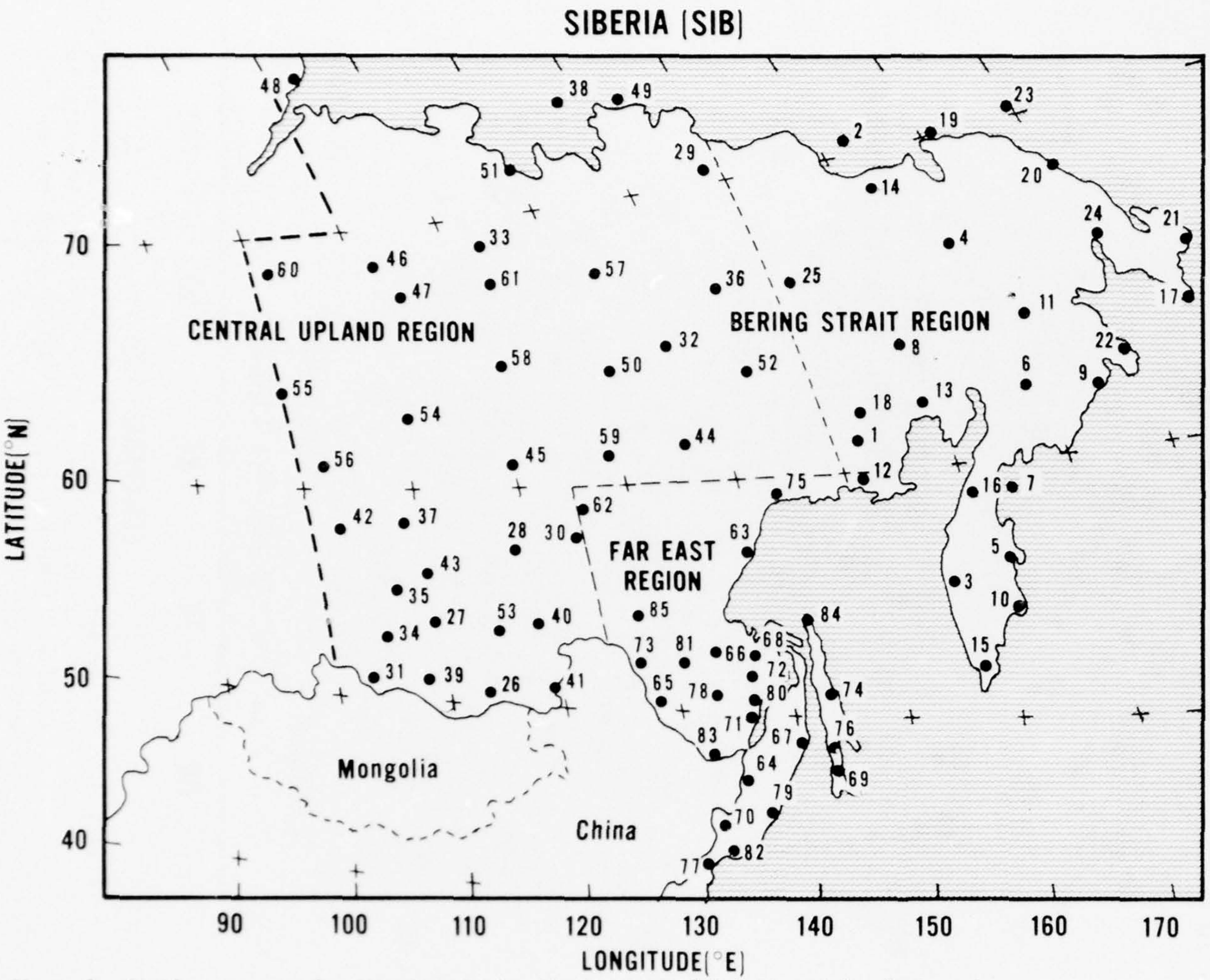

Figure 3. Station coverage for Siberia - Bering Strait, Central Upland, and Far East regions. (See Table 1 for station summaries and data location.)

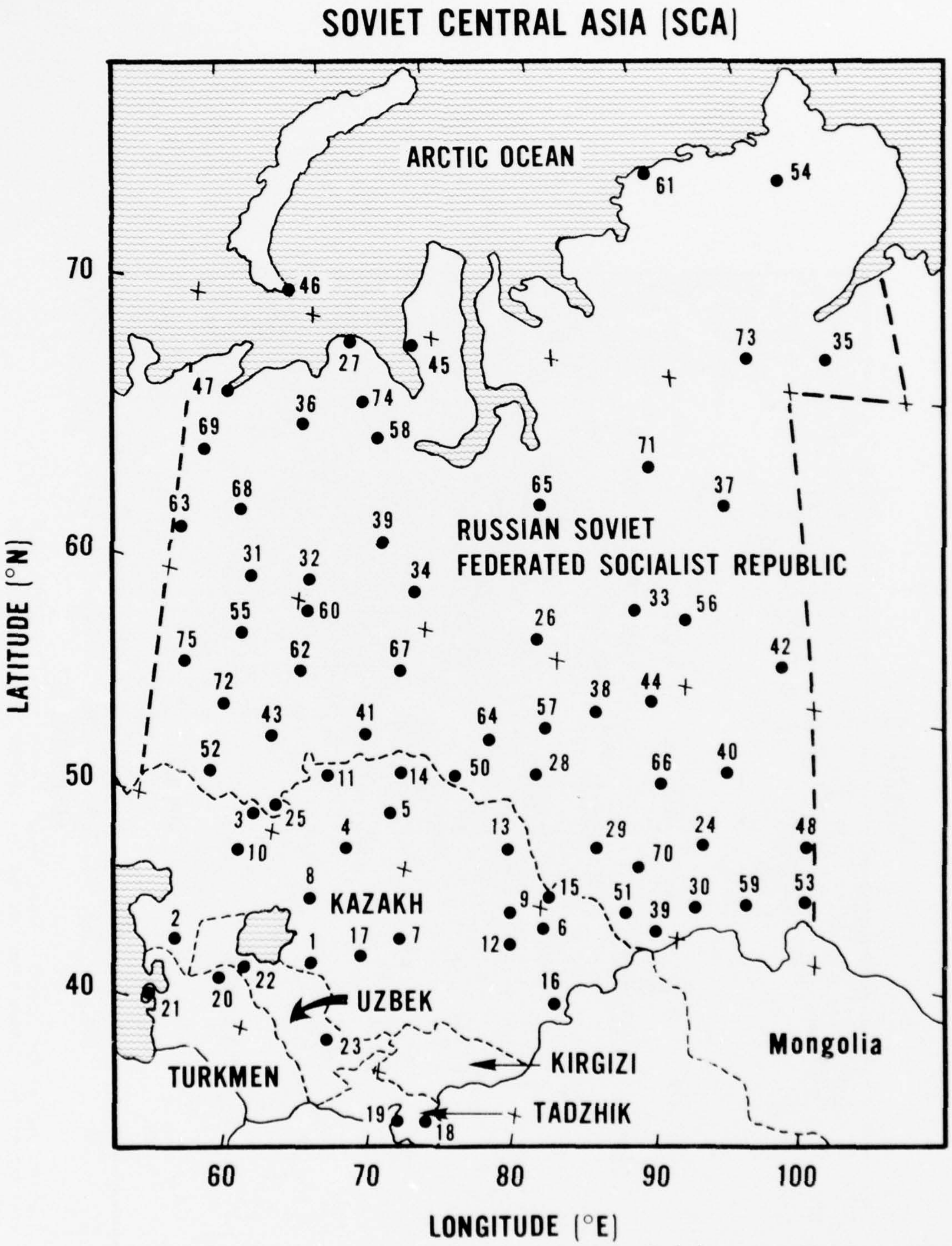

Figure 4. Station coverage for Soviet Central Asia - Kazakh, Tadzhik, Turkmen, Uzbek, and Russian Soviet Federated Socialist Republic. (See Table 2 for station summaries and data location.)

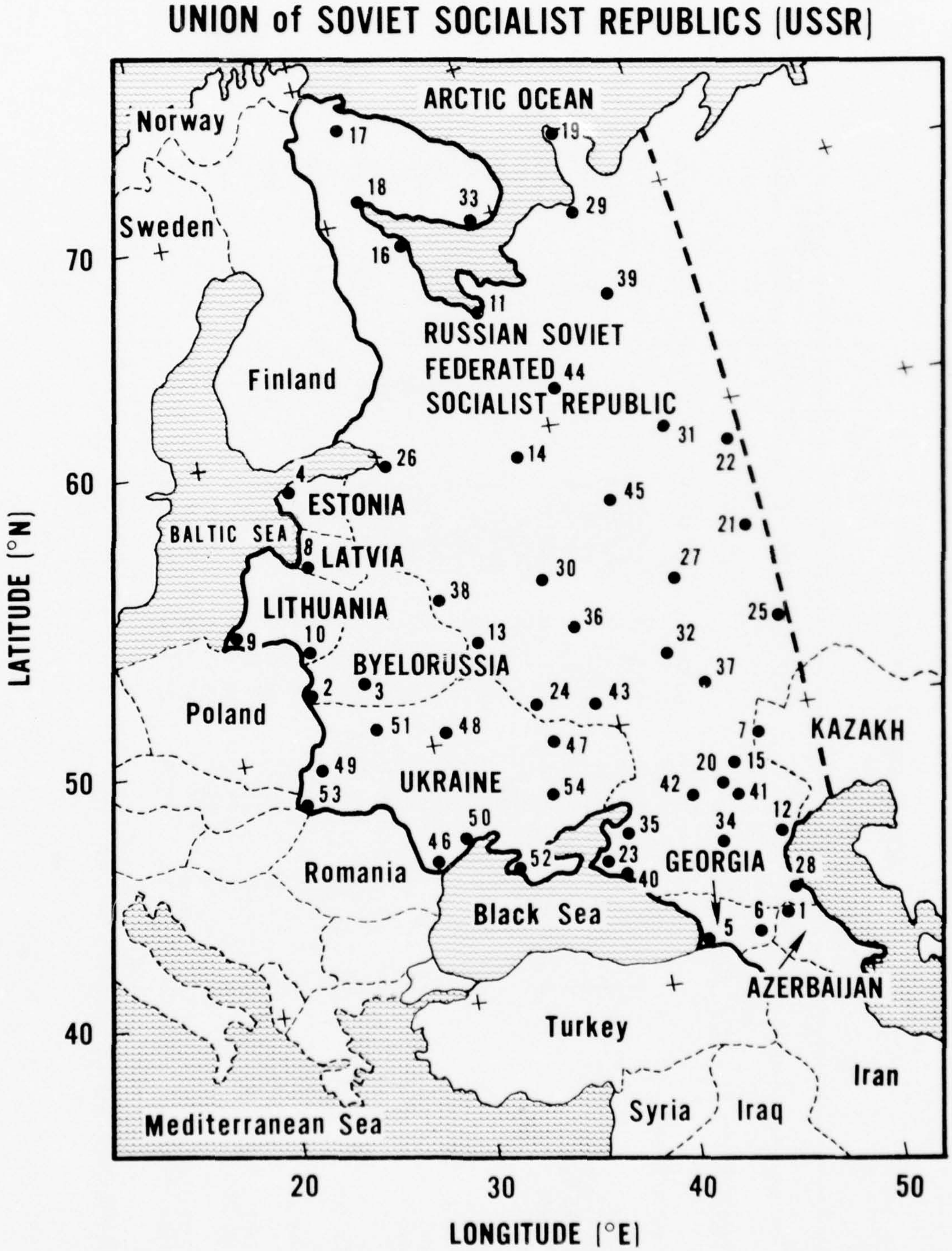

Figure 5. Station coverage for the Union of Soviet Socialist Republics - Azerbaijan, Byelorussia, Estonia, Georgia, Kazakh, Latvia, Lithuania, Russian Soviet Federated Socialist Republic, and Ukraine. (See Table 3 for station summaries and data location.)

TABLE 1

SIBERIA STATION SUMMARY

LOCATION	LOCATORS		WMO NO.	LATITUDE	LONGITUDE	ELEV (m)	DATA	
							<11 km	<1 km
Bering Strait Region	Fig. 3 Sta. No.	Tab.						
Atka	1	5	25902	60°45' N	151°46' E	797	N/A	N/A
Chetyrekhstolbovoy, Ostrov	2	6	21965	70°38' N	162°24' E	6	✓	✓
Ichinskiy	3	7	32411	55°42' N	155°38' E	4	✓	✓
Ilirney	4	8	25248	67°20' N	168°14' E	426	N/A	N/A
Kamchatsk, Ust	5	9	32408	56°13' N	162°28' E	6	✓	✓
Kamenskoye	6	10	25744	62°29' N	166°13' E	34	N/A	N/A
Karaginskiy, Ostrov	7	11	32611	59°00' N	163°55' E	6	N/A	N/A
Kedon	8	12	25621	64°07' N	159°12' E	683	N/A	N/A
Khatyrka	9	13	25767	62°03' N	175°16' E	20	✓	✓
Kronotskiy, Mys	10	14	32519	54°45' N	162°08' E	91	N/A	N/A
Markovo	11	15	25551	64°41' N	170°25' E	33	✓	N/A
Nagayeva	12	16	25913	59°35' N	150°47' E	118	✓	✓
Naya Khan	13	17	25821	61°55' N	158°59' E	23	✓	✓
Nizhniye Krestv	14	18	25123	68°48' N	161°17' E	18	N/A	N/A
Oktyabr'skiy	15	19	32564	52°40' N	156°14' E	7	✓	✓
Palana	16	20	32227	59°06' N	159°59' E	30	N/A	N/A
Provideniya	17	21	25594	64°26' N	173°14' W	3	✓	✓
Seymchan	18	22	25703	62°55' N	152°25' E	207	N/A	N/A
Shelagskiy, Mys	19	23	21978	70°06' N	170°30' E	10	✓	✓
Shmidta, Mys	20	24	25173	68°55' N	179°29' W	7	✓	N/A
Uelen	21	25	25399	66°10' N	169°50' W	7	✓	✓
Ugol'naya, Bukhta	22	26	25677	63°03' N	179°19' E	1	✓	N/A
Vrangelya, Ostrov	23	27	21982	70°58' N	178°32' W	3	✓	✓

N/A = observations with no occurrence of dust

Table 1 (cont)

LOCATION	LOCATORS		WMO NO.	LATITUDE	LONGITUDE	ELEV (m)	DATA <11 km	DATA <1 km
Bering Strait Region (cont)	Fig. 3 Sta. No.	Tab.						
Zaliv Kresta	24	28	25378	66°21' N	179°07' W	15	N/A	N/A
Zyryanka	25	29	25400	65°44' N	150°54' E	40	✓	✓
Central Upland Region	Fig. 3 Sta. No.	Tab.						
Aksha	26	30	30957	50°17' N	113°17' E	734	✓	✓
Barguzin	27	31	30636	53°37' N	190°38' E	486	✓	✓
Chara	28	32	30372	56°55' N	118°22' E	703	✓	✓
Chokurdakh	29	33	21946	70°37' N	147°53' E	48	✓	N/A
Chul'man	30	34	30393	56°50' N	124°52' E	664	✓	✓
Datsan Sanaga	31	35	30911	50°43' N	102°49' E	357	✓	✓
Delinde	32	36	24477	64°57' N	135°55' E	676	N/A	N/A
Dzhardzhan	33	37	24143	68°44' N	124°00' E	47	✓	N/A
Irkutsk	34	38	30710	52°16' N	104°21' E	485	✓	✓
Kachug	35	39	30622	53°58' N	105°52' E	554	✓	N/A
Khonu*	36	40	24382	66°27' N	143°14' E	160	✓	N/A
Kirensk	37	41	30230	57°46' N	108°07' E	261	✓	N/A
Kotel'nyy	38	42	21432	76°00' N	137°54' E	10	✓	N/A
Krasnyy Chikoy	39	43	30935	50°22' N	108°45' E	770	✓	N/A
Mogocha	40	44	30673	53°44' N	119°47' E	619	✓	✓
Nerchinskiy Zavod	41	45	30879	51°19' N	119°37' E	626	✓	N/A
Nevon	42	46	30117	58°02' N	102°44' E	231	N/A	N/A
Nizhne Angarsk	43	47	30433	55°47' N	109°33' E	475	✓	✓
Okhotskiy Perevoz	44	48	24871	61°53' N	135°33' E	140	N/A	N/A
Olekminsk	45	49	24944	60°24' N	120°25' E	226	✓	N/A
Olenek	46	50	24125	68°30' N	112°26' E	127	✓	✓
Onnya-Terde	47	51	24329	66°15' N	114°17' E	235	N/A	N/A
Preobrazheniya, Ostrov	48	52	21504	74°40' N	112°56' E	6	N/A	N/A
Shalaurovo, Mys	49	53	21647	73°11' N	143°56' E	10	✓	N/A

*6/7 observations per day

Table 1 (cont)

LOCATION	LOCATORS Fig. 3 Sta. No.	LOCATORS Tab.	WMO NO.	LATITUDE	LONGITUDE	ELEV (m)	DATA <11 km	DATA <1 km
Central Upland Region (cont)	Fig. 3 Sta. No.	Tab.						
Syuryun Kyuel	50	54	24561	65°21' N	130°20' E	737	✓	✓
Tiksi	51	55	21824	71°35' N	128°55' E	8	✓	✓
Tomtor	52	56	24688	63°16' N	143°09' E	726	✓	N/A
Tungokochen	53	57	30664	53°34' N	115°34' E	812	✓	✓
Tuoy-Khaya	54	58	24724	62°32' N	111°14' E	240	✓	N/A
Tura	55	59	24507	64°10' N	100°04' E	140	N/A	N/A
Vanavara	56	60	24908	60°20' N	102°16' E	260	N/A	N/A
Verkhoyansk	57	61	24266	67°33' N	133°23' E	137	✓	✓
Vilyuysk	58	62	23641	63°46' N	121°37' E	107	✓	N/A
Yakutsk	59	63	24959	62°05' N	129°45' E	103	✓	N/A
Yessey	60	64	24105	68°28' N	102°22' E	200	N/A	N/A
Zhigansk	61	65	23232	66°46' N	123°24' E	58	✓	N/A
Far East Region	Fig. 3 Sta. No.	Tab.						
Aldan	62	66	31004	58°37' N	125°22' E	682	✓	✓
Ayan	63	67	31168	56°27' N	138°09' E	9	✓	✓
Bikin	64	68	31832	46°48' N	134°16' E	62	✓	N/A
Blagoveshchensk	65	69	31510	50°16' N	127°30' E	137	✓	N/A
Ekimchan	66	70	31329	53°04' N	132°56' E	543	✓	✓
Grossevichi	67	71	31823	47°58' N	139°32' E	36	✓	✓
Guga	68	72	31421	52°42' N	137°32' E	50	✓	✓
Il'inskiy	69	73	32121	47°59' N	142°12' E	19	✓	✓
Kamen Rybolov	70	74	31921	44°43' N	132°04' E	75	✓	N/A
Khabarovsk	71	75	31735	48°31' N	135°10' E	72	✓	✓
Kondon	72	76	31489	51°16' N	136°35' E	79	✓	N/A
Kumara	73	77	31444	51°34' N	126°43' E	179	✓	N/A
Nogliki	74	78	32053	51°50' N	143°08' E	44	✓	✓
Okhotsk	75	79	31088	59°22' N	143°12' E	6	✓	✓

Table 1 (cont)

LOCATION	LOCATORS		WMO NO.	LATITUDE	LONGITUDE	ELEV (m)	DATA	
							<11 km	<1 km
Far East Region (cont)	Fig. 3 Sta. No.	Tab.						
Poronaysk	76	80	32098	49°13' N	143°06' E	4	✓	N/A
Poset	77	81	31969	42°39' N	130°48' E	16	✓	N/A
Sutur	78	82	31538	50°04' N	132°08' E	314	✓	✓
Terney	79	83	31909	45°02' N	136°40' E	11	✓	N/A
Troitskoye	80	84	31655	49°27' N	136°34' E	29	✓	N/A
Verkhnyaya	81	85	31459	51°21' N	130°23' E	260	✓	N/A
Vladivostok	82	86	31960	43°07' N	131°54' E	138	✓	✓
Yekaterino Nikolskye	83	87	31707	47°44' N	130°58' E	74	✓	✓
Yelizavety, Mys	84	88	32012	54°25' N	142°43' E	77	✓	✓
Zeya	85	89	31300	53°45' N	127°14' E	232	✓	✓

TABLE 2

SOVIET CENTRAL ASIA STATION SUMMARY

LOCATION	LOCATORS		WMO NO.	LATITUDE	LONGITUDE	ELEV (m)	DATA <11 km	DATA <1 km
Kazakh	Fig. 4 Sta. No.	Tab.						
Akbaytal	1	90	38178	43°09' N	64°20' E	233	✓	✓
Ak Kuduk	2	91	38232	42°58' N	54°07' E	55	✓	✓
Aktyubinsk	3	92	35229	50°17' N	57°09' E	227	✓	✓
Amangel'dy	4	93	35361	50°08' N	65°14' E	142	✓	✓
Atbasar	5	94	35078	51°49' N	68°22' E	308	✓	✓
Ayaguz	6	95	36622	47°56' N	80°23' E	660	✓	N/A
Betpak	7	96	35884	46°01' N	70°12' E	325	✓	N/A
Kara Kum	8	97	35756	46°47' N	79°30' E	79	✓	✓
Kaynar	9	98	36358	49°11' N	77°25' E	842	✓	N/A
Kozhasay	10	99	35529	48°13' N	57°07' E	151	✓	N/A
Kustanay	11	100	28952	53°13' N	63°37' E	171	✓	✓
Mogita Tokubey*	12	101	36761	45°57' N	77°14' E	368	✓	N/A
Pavlodar	13	102	36003	52°17' N	76°57' E	146	✓	✓
Petropavlovsk	14	103	28679	54°50' N	69°09' E	136	✓	✓
Semipalatinsk	15	104	36177	50°21' N	80°15' E	206	✓	✓
Uch-Aral	16	105	36729	46°10' N	80°56' E	388	✓	✓
Zlikha	17	106	35969	45°15' N	67°04' E	138	✓	✓
Tadzhik	Fig. 4 Sta. No.	Tab.						
Akbaytal	18	107	38875	38°29' N	73°53' E	4307	✓	✓
Khorog	19	108	38954	37°30' N	71°30' E	2080	✓	N/A

*Also known under WMO 36761 as Nayman-Suyek

Table 2 (cont)

LOCATION	LOCATORS		WMO NO.	LATITUDE	LONGITUDE	ELEV (m)	DATA	
							<11 km	<1 km
Turkmen	Fig. 4 Sta. No.	Tab.						
Ekedzhe	20	109	38388	41°02' N	57°46' E	59	✓	✓
Krasnovodsk	21	110	38507	40°02' N	52°59' E	80	✓	✓
Uzbek	Fig. 4 Sta. No.	Tab.						
Chimbay	22	111	38262	42°57' N	59°49' E	66	✓	✓
Nurata	23	112	38565	40°33' N	65°41' E	501	✓	✓
RSFSR*	Fig. 4 Sta. No.	Tab.						
Abakan	24	113	29865	53°45' N	91°24' E	245	✓	✓
Adamovka	25	114	35133	51°31' N	59°57' E	285	✓	✓
Aleksandrovskoye	26	115	23955	60°26' N	77°52' E	60	✓	N/A
Amderma	27	116	23022	69°46' N	61°41' E	53	✓	✓
Barabinsk	28	117	29612	55°22' N	78°24' E	120	✓	✓
Barnaul	29	118	29838	53°20' N	83°42' E	196	✓	✓
Chadan	30	119	36087	51°16' N	91°35' E	724	✓	✓
Cherdyn	31	120	23914	60°24' N	56°31' E	206	✓	N/A
Ivdel	32	121	23921	60°41' N	60°26' E	101	✓	N/A
Kellog	33	122	23774	62°32' N	86°10' E	58	✓	N/A
Khanty-Mansiysk	34	123	23933	60°58' N	69°04' E	40	✓	N/A
Khatanga	35	124	20891	71°59' N	102°28' E	24	N/A	N/A
Khoseda-Khard	36	125	23219	67°05' N	59°23' E	81	✓	N/A
Kochumdek	37	126	23585	64°23' N	92°47' E	110	N/A	N/A
Kolpashevo	38	127	29231	58°18' N	82°54' E	76	✓	N/A

*Russian Soviet Federated Socialist Republic

Table 2 (cont)

LOCATION	LOCATORS		WMO NO.	LATITUDE	LONGITUDE	ELEV (m)	DATA	
							<11 km	<1 km
RSFSR (cont)	Fig. 4 Sta. No.	Tab.						
Kosh Agach	39	128	36259	50°01' N	88°44' E	1758	√	N/A
Krasnoyarsk	40	129	29574	56°00' N	92°53' E	194	√	√
Kurgan	41	130	28661	55°28' N	65°24' E	79	√	√
Kuyumba	42	131	23992	60°58' N	96°58' E	196	N/A	N/A
Magnitogorsk	43	132	28838	53°21' N	59°05' E	382	√	√
Maksimkin Yar	44	133	29149	58°41' N	86°49' E	152	√	N/A
Marresale	45	134	23032	69°43' N	66°49' E	11	√	√
Men'shikova, Mys	46	135	20943	70°42' N	57°37' E	10	√	√
Nar'yan-Mar	47	136	23205	67°39' N	53°01' E	7	√	N/A
Nizhneudinsk	48	137	29698	54°53' N	99°02' E	410	√	N/A
Oktyabr'skoye	49	138	23734	62°27' N	66°03' E	38	√	√
Omsk	50	139	28698	54°56' N	73°24' E	94	√	√
Onguday	51	140	36231	50°44' N	86°09' E	832	N/A	N/A
Orenburg	52	141	35121	51°45' N	55°06' E	109	√	N/A
Orlik	53	142	29999	52°30' N	99°49' E	1407	√	√
Ostrov Kupffer	54	143	20594	74°26' N	100°23' E	30	N/A	N/A
Perm	55	144	28225	58°01' N	56°18' E	161	√	√
Podkamennaya Tunguska	56	145	23884	61°36' N	90°00' E	60	√	N/A
Pudino	57	146	29313	57°32' N	79°22' E	110	√	N/A
Salekhard	58	147	23330	66°32' N	66°32' E	35	√	N/A
Saryg-Sep	59	148	36104	51°30' N	95°31' E	706	√	√
Serov	60	149	28044	59°36' N	60°32' E	132	√	N/A
Sterlegova, Mys	61	150	20476	75°24' N	88°40' E	14	√	√
Sverdlovsk	62	151	28440	56°48' N	60°48' E	237	√	√
Syktyvkar	63	152	23804	61°40' N	50°51' E	96	√	N/A
Tara	64	153	28493	56°54' N	74°23' E	74	√	N/A
Tarko Sale	65	154	23552	64°55' N	77°49' E	27	√	N/A
Tisul	66	155	29557	55°45' N	88°19' E	189	√	N/A
Tobol'sk	67	156	28275	58°09' N	68°11' E	44	√	√
Troitsko-Pechorsk	68	157	23711	62°42' N	56°12' E	107	N/A	N/A

Table 2 (cont)

LOCATION	LOCATORS		WMO NO.	LATITUDE	LONGITUDE	ELEV (m)	DATA	
							<11 km	<1 km
RSFSR (cont)	Fig. 4 Sta. No.	Tab.						
Tsil'ma-Ust	69	158	23405	65°27' N	52°10' E	27	✓	N/A
Turochak	70	159	36061	52°16' N	87°10' E	322	✓	✓
Turukhansk	71	160	23472	65°47' N	87°57' E	32	N/A	N/A
Ufa	72	161	28722	54°45' N	56°00' E	197	✓	✓
Volochanka	73	162	20982	70°57' N	94°34' E	38	✓	N/A
Vorkuta	74	163	23226	67°29' N	64°01' E	180	N/A	N/A
Yelabuga	75	164	28506	55°46' N	52°04' E	90	✓	✓

TABLE 3

UNION OF SOVIET SOCIALIST REPUBLICS STATION SUMMARY

LOCATION	LOCATORS		WMO NO.	LATITUDE	LONGITUDE	ELEV (m)	DATA <11 km	DATA <1 km
Azerbaijan	Fig. 5 Sta. No.	Tab.						
Zakataly	1	165	37575	41°38' N	46°39' E	518	✓	✓
Byelorussia	Fig. 5 Sta. No.	Tab.						
Brest	2	166	33008	52°07' N	23°41' E	144	✓	N/A
Minsk	3	167	26850	53°52' N	27°32' E	234	✓	✓
Estonia*	Fig. 5 Sta. No.	Tab.						
Tallinn	4	168	26038	59°25' N	24°48' E	44	✓	N/A
Georgia	Fig. 5 Sta. No.	Tab.						
Batumi	5	169	37484	41°39' N	41°38' E	6	N/A	N/A
Tbilisi	6	170	37549	41°41' N	44°55' E	490	✓	N/A
Kazakh	Fig. 5 Sta. No.	Tab.						
Aleksandrov-Gay	7	171	34391	50°09' N	48°33' E	25	✓	✓

*The United States has not recognized the incorporation of Estonia into the Soviet Union.

Table 3 (cont)

LOCATION	LOCATORS		WMO NO.	LATITUDE	LONGITUDE	ELEV (m)	DATA <11 km	DATA <1 km
Latvia*	Fig. 5 Sta. No.	Tab.						
Riga	8	172	26422	56°58' N	24°04' E	3	✓	N/A
Lithuania	Fig. 5 Sta. No.	Tab.						
Kaliningrad	9	173	26702	54°42' N	20°37' E	27	✓	N/A
Kaunas	10	174	26629	54°53' N	23°53' E	75	N/A	N/A
RSFSR**	Fig. 5 Sta. No.	Tab.						
Archangel	11	175	22550	64°35' N	40°30' E	13	✓	N/A
Astrakhan	12	176	34880	46°16' N	48°02' E	18	✓	✓
Bryansk	13	177	26898	53°20' N	34°14' E	162	N/A	N/A
Cherepovets	14	178	27113	59°07' N	37°56' E	131	✓	N/A
El'ton	15	179	34476	49°08' N	46°51' E	11	✓	✓
Gridino	16	180	22422	65°54' N	34°46' E	10	N/A	N/A
Gryaznaya	17	181	22018	69°05' N	33°17' E	80	N/A	N/A
Kandalaksha	18	182	22217	67°08' N	32°26' E	26	✓	N/A
Kanin Nos	19	183	22165	68°39' N	43°18' E	48	N/A	N/A
Kapustin Yar	20	184	34571	48°35' N	45°43' E	9	✓	✓
Kazan	21	185	27595	55°47' N	49°11' E	64	✓	✓
Kirov	22	186	27196	58°39' N	49°37' E	164	✓	✓
Krasnodar	23	187	34929	45°02' N	39°09' E	33	✓	✓
Kursk	24	188	34009	51°45' N	36°12' E	167	✓	✓
Kuybyshev	25	189	28900	53°15' N	50°27' E	44	✓	N/A
Leningrad	26	190	26063	59°58' N	30°18' E	4	✓	N/A
Lukoyanov	27	191	27665	55°02' N	44°30' E	206	✓	N/A

*The United States has not recognized the incorporation of Latvia into the Soviet Union.

**Russian Soviet Federated Socialist Republic

Table 3 (cont)

LOCATION	LOCATORS		WMO NO.	LATITUDE	LONGITUDE	ELEV (m)	DATA <11 km	DATA <1 km
RSFSR (cont)	Fig. 5 Sta. No.	Tab.						
Makhachkala	28	192	37472	43°01' N	47°26' E	14	✓	✓
Mezen	29	193	22471	65°52' N	44°13' E	14	✓	✓
Moscow	30	194	27612	55°45' N	37°34' E	156	✓	N/A
Nikol'sk	31	195	27066	59°32' N	45°27' E	136	✓	N/A
Penza	32	196	27962	53°08' N	45°01' E	174	✓	N/A
Prikumsk	33	197	37061	44°48' N	44°10' E	118	✓	✓
Pyalitsa	34	198	22349	66°10' N	39°32' E	8	✓	✓
Rostov-on-the-Don	35	199	34731	47°15' N	39°49' E	77	✓	✓
Ryazan	36	200	27731	54°37' N	39°43' E	135	✓	N/A
Saratov	37	201	34172	51°34' N	46°02' E	156	✓	✓
Smolensk	38	202	26781	54°45' N	32°04' E	241	✓	✓
Sura	39	203	22676	63°35' N	45°38' E	66	✓	N/A
Tuapse	40	204	37018	44°06' N	39°04' E	79	✓	✓
Verkhniy Baskunchak	41	205	34579	48°13' N	46°44' E	35	✓	✓
Volgograd	42	206	34560	48°41' N	44°21' E	145	✓	✓
Voronezh	43	207	34122	51°42' N	39°10' E	164	✓	N/A
Vozhega	44	208	22954	60°28' N	40°12' E	178	✓	✓
Yur'yevets	45	209	27355	57°20' N	43°07' E	132	✓	N/A
Ukraine	Fig. 5 Sta. No.	Tab.						
Bolgrad	46	210	33887	45°40' N	28°37' E	81	✓	✓
Khar'kov	47	211	34300	49°56' N	36°17' E	152	✓	✓
Kiev	48	212	33345	50°24' N	30°27' E	179	✓	N/A
L'vov	49	213	33393	49°49' N	23°57' E	325	✓	✓
Odessa	50	214	33837	46°29' N	30°38' E	64	✓	✓
Sarny	51	215	33088	51°21' N	26°37' E	153	✓	✓
Simferopol	52	216	33946	45°02' N	33°59' E	204	✓	✓
Uzhgorod	53	217	33631	48°38' N	22°16' E	118	✓	N/A
Zaporozh'ye	54	218	34601	47°48' N	35°15' E	86	✓	✓

TABLE 4

MAP CHARTS OF THE OCCURRENCE OF DUST
OVER THE USSR

Type	Geographical Area(s)	Reference	Reproduced on Page
I	Ukraine	Babichenko (1965)	261
		Babichenko and Kulakovskaya (1970)	289
		Dolgilevich (1966)	317
		Romushkevich (1967)	352
		Sapozhnikova (1970)	356
		Zakharov (1966)	373
	Kazakh	Sapozhnikova (1970)	356
		Zakharov (1966)	373
	Siberia	Dolgilevich and Sazhin (1973)	330
	USSR	Chirkov (1970)	307
II	Ukraine	Babichenko (1965)	263
	Kazakh	Seredkina (1960)	364
III	Siberia	Dolgilevich and Sazhin (1973)	334

I Average number of days (per year, per season)
II Maximum number of days per year
III Average duration

TABLE 5

OCCURRENCE OF DUST - ATKA, BERING STRAIT REGION, SIBERIA (Jan 59 - Dec 68)

FIGURE 3 STATION 1

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0			DUST STORMS (visibility <1 km)										
01														
04														
07														
10														
13						NONE REPORTED								
16														
19														
22														
Avg														
	N = 0			BLOWING DUST (visibility <11 km)										
01														
04														
07														
10														
13														
16						NONE REPORTED								
19														
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 6

OCCURRENCE OF DUST - CHETYREKHSTOLBOVOY, OSTROV, BERING STRAIT REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 2

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.1			DUST STORMS (visibility <1 km)										
02													1	1.00
05													3	0.63
08													6	0.63
11													9	
14								*					12	
17								*					24	
20														
23								*						
Avg														
	N = 0.4			BLOWING DUST (visibility <11 km)										
02						*							1	1.00
05					*							*	3	0.54
08												*	6	0.43
11	*												9	
14	*												12	
17								*					24	
20								*						
23						*								
Avg	*				*	*		*				*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 7

OCCURRENCE OF DUST - ICHINSKIY, BERING STRAIT REGION, SIBERIA (May 55 - Dec 68)

FIGURE 3 STATION 3

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
						DUST STORMS (visibility <1 km)								
01	N = 0.1												1	1.00
04													3	1.00
07								*					6	
10													9	
13													12	
16													24	
19														
22														
Avg								*						
						BLOWING DUST (visibility <11 km)								
	N = 0.1													
01													1	1.00
04								*					3	1.00
07													6	
10													9	
13													12	
16													24	
19														
22														
Avg								*						

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 8

OCCURRENCE OF DUST - ILIRNEY, BERING STRAIT REGION, SIBERIA (Jan 59 - Dec 68)

FIGURE 3 STATION 4

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
01														
04														
07														
10														
13						NONE REPORTED								
16														
19														
22														
Avg														
	N = 0				BLOWING DUST (visibility <11 km)									
01														
04														
07														
10						NONE REPORTED								
13														
16														
19														
22														
Avg														

N = Aritnmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 9

OCCURRENCE OF DUST - KAMCHATSK, UST, BERING STRAIT REGION, SIBERIA (Jan 48 - Dec 63)

FIGURE 3 STATION 5

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	N = 0.1					DUST STORMS (visibility <1 km)								
02													1	1.00
05													3	1.00
08													6	
11						*							9	
14													12	
17													24	
20														
23											*			
Avg						*					*			
	N = 0.1					BLOWING DUST (visibility <11 km)								
02													1	1.00
05													3	1.00
08													6	
11						*							9	
14													12	
17													24	
20														
23											*			
Avg						*					*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 10

OCCURRENCE OF DUST - KAMENSKOYE, BERING STRAIT REGION, SIBERIA (May 55 - Dec 68)

FIGURE 3 STATION 6

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
01														
04														
07														
10														
13						NONE REPORTED								
16														
19														
22														
Avg														
	N = 0				BLOWING DUST (visibility <11 km)									
01														
04														
07														
10						NONE REPORTED								
13														
16														
19														
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 11

OCCURRENCE OF DUST - KARAGINSKIY, OSTROV, BERING STRAIT REGION, SIBERIA (Apr 53 - Jun 68)

FIGURE 3 STATION 7

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0			DUST STORMS (visibility <1 km)										
01														
04														
07														
10						NONE REPORTED								
13														
16														
19														
22														
Avg														
	N = 0			BLOWING DUST (visibility <11 km)										
01														
04														
07														
10						NONE REPORTED								
13														
16														
19														
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 12

OCCURRENCE OF DUST - KEDON, BERING STRAIT REGION, SIBERIA (Jan 59 - Dec 68)

FIGURE 3 STATION 8

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
N = 0	DUST STORMS (visibility <1 km)													
01														
04														
07														
10														
13	NONE REPORTED													
16														
19														
22														
Avg														
N = 0	BLOWING DUST (visibility <11 km)													
01														
04														
07														
10														
13	NONE REPORTED													
16														
19														
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 13

OCCURRENCE OF DUST - KHATYRKA, BERING STRAIT REGION, SIBERIA (Apr 55 - Dec 68)

FIGURE 3 STATION 9

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.1			DUST STORMS (visibility <1 km)										
00													1	1.00
03													3	0.66
06													6	0.66
09													9	
12								*					12	
15								*					24	
18														
21														
Avg								*						
	N = 0.2			BLOWING DUST (visibility <1 km)										
00													1	1.00
03													3	0.63
06													6	0.63
09													9	
12						*		*					12	
15						*		*					24	
18														
21														
Avg						*		*						

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 14

OCCURRENCE OF DUST - KRONOTSKIY, MYS, BERING STRAIT REGION, SIBERIA (May 55 - Dec 68)

FIGURE 3 STATION 10

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02														
05														
08														
11						NONE REPORTED								
14														
17														
20														
23														
Avg														
	N = 0				BLOWING DUST (visibility <11 km)									
02														
05														
08														
11														
14						NONE REPORTED								
17														
20														
23														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 15

OCCURRENCE OF DUST - MARKOVO, BERING STRAIT REGION, SIBERIA (Sep 47 - Dec 68)

FIGURE 3 STATION 11

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02													1	
05													3	
08													6	
11						NONE REPORTED							9	
14													12	
17													24	
20														
23														
Avg														
	N = 0.1				BLOWING DUST (visibility <11 km)									
02													1	1.00
05													3	1.00
08													6	
11													9	
14													12	
17													24	
20														
23				*										
Avg				*										

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 16

OCCURRENCE OF DUST - NAGAYEVA, BERING STRAIT REGION, SIBERIA (Jan 46 - Dec 68)

FIGURE 3 STATION 12

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
					DUST STORMS (visibility <1 km)									
01	N = 0.5												1	1.00
04													3	0.31
07													6	0.05
10					*								9	
13													12	
16													24	
19									*					
22								*	*					
Avg					*			*	*					
					BLOWING DUST (visibility <11 km)									
01	N = 1												1	1.00
04													3	0.21
07										*			6	0.04
10					*		*						9	
13													12	
16													24	
19									*					
22								*	*					
Avg					*		*	*	*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 17

OCCURRENCE OF DUST - NAYA KHAN, BERING STRAIT REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 13

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.1				DUST STORMS (visibility <1 km)									
02													1	1.00
05													3	0.67
08									*				6	0.67
11									*				9	
14													12	
17													24	
20														
23														
Avg									*					
	N = 0.3				BLOWING DUST (visibility <11 km)									
02													1	1.00
05							*						3	0.64
08							*		*				6	0.64
11									*				9	
14									*				12	
17													24	
20														
23														
Avg							*		*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 18

OCCURRENCE OF DUST - NIZHNIYE KRESTY, BERING STRAIT REGION, SIBERIA (Mar 55 - Dec 68)

FIGURE 3 STATION 14

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours $\geq$	Duration Factor: Decimal Percent
N = 0	DUST STORMS (visibility <1 km)													
01														
04														
07														
10														
13	NONE REPORTED													
16														
19														
22														
Avg														
N = 0	BLOWING DUST (visibility <11 km)													
01														
04														
07														
10														
13	NONE REPORTED													
16														
19														
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 19

OCCURRENCE OF DUST - OKTYABR'SKIY, BERING STRAIT REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 15

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
N = 0.1					DUST STORMS (visibility <1 km)									
01													1	1.00
04													3	1.00
07													6	
10									*				9	
13													12	
16										*			24	
19														
22														
Avg									*	*				
N = 1					BLOWING DUST (visibility <11 km)									
01							*						1	1.00
04	*												3	0.22
07									*				6	0.04
10													9	
13													12	
16	*									*			24	
19														
22							*							
Avg	*						*		*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 20

OCCURRENCE OF DUST - PALANA, BERING STRAIT REGION, SIBERIA (MAY 55 - DEC 68)

FIGURE 3 STATION 16

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
N = 0	DUST STORMS (visibility <1 km)													
01														
04														
07														
10														
13														
16	NONE REPORTED													
19														
22														
Avg														
N = 0	BLOWING DUST (visibility <11 km)													
01														
04														
07														
10														
13														
16														
19	NONE REPORTED													
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 21

OCCURRENCE OF DUST - PROVIDENIYA, BERING STRAIT REGION, SIBERIA (Aug 47 - Dec 68)

FIGURE 3 STATION 17

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0.1				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	0.63
06													6	0.63
09													9	
12						*							12	
15						*							24	
18														
21														
Avg						*								
	N = 0.6				BLOWING DUST (visibility <11 km)									
00								*	*				1	1.00
03								*					3	0.55
06							*			*			6	0.48
09							*			*			9	
12						*	*						12	
15						*	*						24	
18														
21														
Avg						*	*	*	*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 22

OCCURRENCE OF DUST - SEYMCHAN, BERING STRAIT REGION, SIBERIA (Jan 59 - Dec 68)

FIGURE 3 STATION 18

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
N = 0	DUST STORMS (visibility <1 km)													
01														
04														
07														
10														
13														
16	NONE REPORTED													
19														
22														
Avg														
N = 0	BLOWING DUST (visibility <11 km)													
01														
04														
07														
10														
13														
16	NONE REPORTED													
19														
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 23

OCCURRENCE OF DUST - SHELAGSKIY, MYS, BERING STRAIT REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 19

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.1				DUST STORMS (visibility <1 km)									
02													1	1.00
05			*										3	0.63
08			*										6	0.63
11													9	
14													12	
17													24	
20														
23														
Avg			*											
	N = 0.9				BLOWING DUST (visibility <11 km)									
02													1	1.00
05			*										3	0.43
08			1										6	0.25
11	*								*				9	
14													12	
17						1							24	
20						1								
23					*									
Avg	*		*		*	*			*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 24

OCCURRENCE OF DUST - SHMIDTA, MYS, BERING STRAIT REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 20

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09													9	
12						NONE REPORTED							12	
15													24	
18														
21														
Avg														
	N = 0.4				BLOWING DUST (visibility <11 km)									
00						*							1	1.00
03						*							3	0.64
06							*						6	0.64
09							*						9	
12													12	
15										*			24	
18					*					*				
21					*									
Avg					*	*	*			*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 25

OCCURRENCE OF DUST - UELEN, BERING STRAIT REGION, SIBERIA (Aug 46 - Dec 68)

FIGURE 3 STATION 21

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.7				DUST STORMS (visibility <1 km)									
00					*								1	1.00
03													3	0.40
06				*									6	0.20
09				*									9	
12											*		12	
15											*		24	
18	*													
21														
Avg	*			*	*						*			
	N = 1				BLOWING DUST (visibility <11 km)									
00				*	*								1	1.00
03				*									3	0.37
06				*									6	0.17
09				*									9	
12									*		*		12	
15									*		*	*	24	
18	*							*	*					
21														
Avg	*			*	*			*	*		*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 26

OCCURRENCE OF DUST - UGOL'NAYA, BUKHTA, BERING STRAIT REGION, SIBERIA (Mar 55 - Dec 68)

FIGURE 3 STATION 22

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	Diurnal Variation by Month (%)													
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 1				BLOWING DUST (visibility <11 km)									
00		*											1	1.00
03													3	0.14
06													6	0.01
09													9	
12												1	12	
15													24	
18														
21		*												
Avg		*										*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 27

OCCURRENCE OF DUST - VRANGELYA, OSTROV, BERING STRAIT REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 23

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	N = 0.3				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	0.60
06													6	0.60
09													9	
12						*					*		12	
15						*			*		*		24	
18									*					
21														
Avg						*			*		*			
	N = 0.9				BLOWING DUST (visibility <11 km)									
00											*	*	1	1.00
03												*	3	0.52
06													6	0.38
09													9	
12	*				*	*					*		12	
15	*				*	*			*		*		24	
18									*					
21														
Avg	*				*	*			*		*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 28

OCCURRENCE OF DUST - ZALIV KRESTA, BERING STRAIT REGION, SIBERIA (Aug 47 - Dec 68)

FIGURE 3 STATION 24

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0			DUST STORMS (visibility <1 km)										
00														
03														
06														
09					NONE REPORTED									
12														
15														
18														
21														
Avg														
	N = 0			BLOWING DUST (visibility <11 km)										
00														
03														
06														
09					NONE REPORTED									
12														
15														
18														
21														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 29

OCCURRENCE OF DUST - ZYRYANKA, BERING STRAIT REGION, SIBERIA (Jan 46 - Dec 68)

FIGURE 3 STATION 25

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
N = 0.06					DUST STORMS (visibility <1 km)									
01													1	1.00
04													3	1.00
07													6	
10													9	
13													12	
16							*						24	
19														
22														
Avg							*							
N = 1					BLOWING DUST (visibility <11 km)									
01													1	1.00
04													3	0.25
07													6	0.06
10									*				9	
13													12	
16						*	*						24	
19					*	*								
22														
Avg					*	*	*		*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 30

OCCURRENCE OF DUST - AKSHA, CENTRAL UPLAND REGION, SIBERIA (JAN 48 - DEC 68)

FIGURE 3 STATION 26

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
N = 0.4						DUST STORMS (visibility <1 km)								
02										*	*		1	1.00
05										*	*		3	0.51
08													6	0.38
11				*									9	
14				*									12	
17													24	
20														
23														
Avg				*						*	*			
N = 2						BLOWING DUST (visibility <11 km)								
02	*									*	*		1	1.00
05	*									*	*		3	0.55
08					*								6	0.31
11				*	*								9	0.08
14			1	1	*								12	0.06
17		*	*	1	*	*							24	
20	*			*			*							
23	*			*										
Avg	*	*	*	*	*	*	*			*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 31

OCCURRENCE OF DUST - BARGUZIN, CENTRAL UPLAND REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 27

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
N = 0.05	DUST STORMS (visibility <1 km)													
01													1	1.00
04													3	1.00
07													6	1.00
10						*							9	1.00
13						*							12	
16						*							24	
19														
22														
Avg						*								
N = 0.4	BLOWING DUST (visibility <11 km)													
01													1	1.00
04													3	0.59
07												*	6	0.24
10	*					*						*	9	0.12
13						*							12	
16	*					*							24	
19														
22														
Avg	*					*						*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 32

OCCURRENCE OF DUST - CHARA, CENTRAL UPLAND REGION, SIBERIA, (Jan 48 - Dec 68)

FIGURE 3 STATION 28

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.05				DUST STORMS (visibility <1 km)									
02													1	1.00
05													3	1.00
08								*					6	
11													9	
14													12	
17													24	
20														
23														
Avg								*						
	N = 0.5				BLOWING DUST (visibility <11 km)									
02											*		1	1.00
05											*		3	0.30
08								*					6	0.11
11													9	
14													12	
17													24	
20														
23								*						
Avg								*			*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 33

OCCURRENCE OF DUST - CHOKURDAKH, CENTRAL UPLAND REGION, SIBERIA (Mar 55 - Dec 68)

FIGURE 3 STATION 29

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
01													1	
04													3	
07													6	
10						NONE REPORTED							9	
13													12	
16													24	
19														
22														
Avg														
	N = 1				BLOWING DUST (visibility <11 km)									
01													1	1.00
04						*		*					3	0.25
07													6	0.06
10								*					9	
13								*					12	
16						*							24	
19														
22														
Avg						*		*						

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 34

OCCURRENCE OF DUST - CHUL'MAN, CENTRAL UPLAND REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 30

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	Diurnal Variation by Month (%)												Duration Factor	
N = 0.3					DUST STORMS (visibility <1 km)									
02													1	1.00
05													3	0.47
08		*											6	0.33
11		*											9	
14													12	
17								*					24	
20	*													
23	*													
Avg	*	*						*						
N = 0.4					BLOWING DUST (visibility <11 km)									
02								*					1	1.00
05								*					3	0.55
08		*			*								6	0.43
11		*			*								9	
14													12	
17								*					24	
20	*													
23	*													
Avg	*	*			*			*						

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 35

OCCURRENCE OF DUST - DATSAN SANAGA, CENTRAL UPLAND REGION, SIBERIA (Mar 55 - Dec 68)

FIGURE 3 STATION 31

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
N = 0.1					DUST STORMS (visibility <1 km)									
01													1	1.00
04													3	1.00
07													6	
10					*								9	
13													12	
16													24	
19				*										
22														
Avg				*	*									
N = 0.2					BLOWING DUST (visibility <11 km)									
01													1	1.00
04													3	1.00
07													6	
10					*								9	
13													12	
16													24	
19				*										
22									*					
Avg				*	*				*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 36

OCCURRENCE OF DUST - DELINDE, CENTRAL UPLAND REGION, SIBERIA (Jan 59 - Dec 68)

FIGURE 3 STATION 32

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00														
03														
06														
09						NONE REPORTED								
12														
15														
18														
21														
Avg														
	N = 0				BLOWING DUST (visibility <11 km)									
00														
03														
06														
09						NONE REPORTED								
12														
15														
18														
21														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 37

OCCURRENCE OF DUST - DZHARDZHAN, CENTRAL UPLAND REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 33

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
N = 0					DUST STORMS (visibility <1 km)									
02													1	
05													3	
08													6	
11					NONE REPORTED								9	
14													12	
17													24	
20														
23														
Avg														
N = 0.2					BLOWING DUST (visibility <11 km)									
02													1	1.00
05													3	0.68
08													6	0.45
11													9	0.23
14					*				*	*			12	
17					*				*				24	
20									*					
23														
Avg					*				*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 38

OCCURRENCE OF DUST - IRKUTSK, CENTRAL UPLAND REGION, SIBERIA (Feb 53 - Dec 68)

FIGURE 3 STATION 34

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.1				DUST STORMS (visibility <1 km)									
01													1	1.00
04													3	0.63
07													6	0.63
10													9	
13													12	
16													24	
19									*					
22									*					
Avg									*					
	N = 7				BLOWING DUST (visibility <11 km)									
01					*	*							1	1.00
04				*									3	0.27
07				*			*		*				6	0.08
10				*			*		*	1			9	
13			*										12	
16					*	*			*	*			24	
19					1	*	*		*	*				
22					1	*			1					
Avg			*	*	*	*	*		*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 39

OCCURRENCE OF DUST - KACHUG, CENTRAL UPLAND REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 35

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
N = 0				DUST STORMS (visibility <1 km)										
01													1	
04													3	
07													6	
10													9	
13						NONE REPORTED							12	
16													24	
19														
22														
Avg														
N = 0.7				BLOWING DUST (visibility <11 km)										
01					*		*						1	1.00
04				*	*		*						3	0.40
07													6	0.19
10													9	
13					*								12	
16					*								24	
19														
22														
Avg				*	*		*							

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 40

OCCURRENCE OF DUST - KHONU, CENTRAL UPLAND REGION, SIBERIA (Jan 59 - Dec 68)'

FIGURE 3 STATION 36

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
													Duration Factor	
N = 0					DUST STORMS (visibility <1 km)									
01													1	
04													3	
07													6	
10					NONE REPORTED								9	
13													12	
16													24	
19														
22														
Avg														
N = 0·2					BLOWING DUST (visibility <11 km)									
01													1	1.00
04													3	0.63
07													6	0.63
10													9	
13													12	
16					*								24	
19					*									
22														
Avg					*									

Columns J–D: Diurnal Variation by Month (%)

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

' Based on 6 to 7 observations per day instead of 8

TABLE 41

OCCURRENCE OF DUST - KIRENSK, CENTRAL UPLAND REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 37

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
													Duration Factor	
	N = 0				DUST STORMS (visibility <1 km)									
01													1	
04													3	
07													6	
10													9	
13						NONE REPORTED							12	
16													24	
19														
22														
Avg														
	N = 0.3				BLOWING DUST (visibility <11 km)									
01								*	*				1	1.00
04								*	*				3	0.63
07	*	*											6	0.63
10	*	*											9	
13													12	
16													24	
19														
22														
Avg	*	*						*	*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 42

OCCURRENCE OF DUST - KOTEL-NYY, CENTRAL UPLAND REGION, SIBERIA (Mar 55 - Dec 68)

FIGURE 3 STATION 38

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.4				BLOWING DUST (visibility <11 km)									
00													1	1.00
03													3	0.40
06													6	0.20
09													9	
12													12	
15					*								24	
18					*									
21					*									
Avg					*									

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 43

OCCURRENCE OF DUST - KRASNYY CHIKOY, CENTRAL UPLAND REGION, SIBERIA (Mar 55 - Dec 68)

FIGURE 3 STATION 39

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
N = 0					DUST STORMS (visibility <1 km)									
01													1	
04													3	
07													6	
10													9	
13						NONE REPORTED							12	
16													24	
19														
22														
Avg														
N = 0.4					BLOWING DUST (visibility <11 km)									
01													1	1.00
04													3	0.40
07													6	0.20
10													9	
13						*							12	
16						*							24	
19														
22					*									
Avg					*	*								

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 44

OCCURRENCE OF DUST - MOGOCHA, CENTRAL UPLAND REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 40

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
N = 0.05					DUST STORMS (visibility <1 km)									
02								*					1	1.00
05													3	1.00
08													6	
11													9	
14													12	
17													24	
20														
23														
Avg								*						
N = 0.8					BLOWING DUST (visibility <11 km)									
02					*	*	*	*					1	1.00
05					1	*							3	0.46
08													6	0.29
11													9	
14												*	12	
17												*	24	
20														
23										*				
Avg					*	*	*	*		*		*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 45

OCCURRENCE OF DUST - NERCHINSKIY ZAVOD, CENTRAL UPLAND REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 41

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
N = 0	DUST STORMS (visibility <1 km)													
02													1	
05													3	
08						NONE REPORTED							6	
11													9	
14													12	
17													24	
20														
23														
Avg														
N = 0.8	BLOWING DUST (visibility <11 km)													
02										1			1	1.00
05													3	0.51
08													6	0.25
11													9	0.05
14													12	
17													24	
20										2				
23										1				
Avg										*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 46

OCCURRENCE OF DUST - NEVON, CENTRAL UPLAND REGION, SIBERIA (Feb 53 - Dec 68)

FIGURE 3 STATION 42

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
N = 0	DUST STORMS (visibility <1 km)													
01														
04														
07														
10														
13	NONE REPORTED													
16														
19														
22														
Avg														
N = 0	BLOWING DUST (visibility <11 km)													
01														
04														
07														
10														
13														
16	NONE REPORTED													
19														
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 47

OCCURRENCE OF DUST - NIZHNE ANGARSK, CENTRAL UPLAND REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 43

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
N = 0.08					DUST STORMS (visibility <1 km)									
01						*							1	1.00
04							*						3	0.63
07													6	0.63
10													9	
13													12	
16													24	
19														
22														
Avg						*	*							
N = 0.4					BLOWING DUST (visibility <11 km)									
01						*			*				1	1.00
04							*		*				3	0.55
07						*							6	0.43
10						*							9	
13							*						12	
16							*						24	
19									*					
22														
Avg						*	*		*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 48

OCCURRENCE OF DUST - OKHOTSKIY PEREVOZ, CENTRAL UPLAND REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 44

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
N = 0	DUST STORMS (visibility <1 km)													
01														
04														
07														
10														
13														
16	NONE REPORTED													
19														
22														
Avg														
N = 0	BLOWING DUST (visibility <11 km)													
01														
04														
07														
10														
13														
16														
19	NONE REPORTED													
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 49

OCCURRENCE OF DUST - OLEKMINSK, CENTRAL UPLAND REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 45

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
N = 0					DUST STORMS (visibility <1 km)									
02													1	
05													3	
08													6	
11						NONE REPORTED							9	
14													12	
17													24	
20														
23														
Avg														
N = 0.2					BLOWING DUST (visibility <11 km)									
02													1	1.00
05													3	0.42
08		*										*	6	0.21
11		*											9	
14													12	
17													24	
20														
23														
Avg		*										*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 50

OCCURRENCE OF DUST - OLENEK, CENTRAL UPLAND REGION, SIBERIA (Jan 59 - Dec 68)

FIGURE 3 STATION 46

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
N = 0.2					DUST STORMS (visibility <1 km)									
01													1	1.00
04													3	0.63
07								*					6	0.63
10								*					9	
13													12	
16													24	
19														
22														
Avg								*						
N = 0.5					BLOWING DUST (visibility <11 km)									
01													1	1.00
04													3	0.40
07								*					6	0.20
10								*					9	
13													12	
16								*					24	
19														
22														
Avg								*						

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 51

OCCURRENCE OF DUST - ONNYA-TERDE, CENTRAL UPLAND REGION, SIBERIA (Jul 57 - Dec 68)

FIGURE 3 STATION 47

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
N = 0	DUST STORMS (visibility <1 km)													
02														
05														
08														
11	NONE REPORTED													
14														
17														
20														
23														
Avg														
N = 0	BLOWING DUST (visibility <11 km)													
02														
05														
08														
11	NONE REPORTED													
14														
17														
20														
23														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 52

OCCURRENCE OF DUST - PREOBRAZHENIYA, OSTROV, CENTRAL UPLAND REGION, SIBERIA (Mar 55 - Dec 68)

FIGURE 3 STATION 48

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
N = 0	DUST STORMS (visibility <1 km)													
02														
05														
08														
11														
14	NONE REPORTED													
17														
20														
23														
Avg														
N = 0	BLOWING DUST (visibility <11 km)													
02														
05														
08														
11	NONE REPORTED													
14														
17														
20														
23														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 53

OCCURRENCE OF DUST - SHALAUROVA, MYS, CENTRAL UPLAND REGION, SIBERIA (Mar 55 - Dec 68)

FIGURE 3 STATION 49

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
N = 0						DUST STORMS (visibility <1 km)								
01													1	
04													3	
07													6	
10													9	
13													12	
16						NONE REPORTED							24	
19														
22														
Avg														
N = 1						BLOWING DUST (visibility <11 km)								
01													1	1.00
04				*							*		3	0.40
07											*		6	0.25
10													9	
13			*										12	
16						*			*				24	
19						*			*					
22							*							
Avg			*	*		*	*		*		*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 54

OCCURRENCE OF DUST - SYURYUN KYUEL, CENTRAL UPLAND REGION, SIBERIA (Jul 57 - Dec 68)

FIGURE 3 STATION 50

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0					DUST STORMS (visibility <1 km)								
01														
04														
07														
10														
13							NONE REPORTED							
16														
19														
22														
Avg														
	N = 0					BLOWING DUST (visibility <11 km)								
01														
04														
07														
10														
13							NONE REPORTED							
16														
19														
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 55

OCCURRENCE OF DUST - TIKSI, CENTRAL UPLAND REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 51

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	N = 0.3				DUST STORMS (visibility <1 km)									
00													1	1.00
03		*										*	3	0.71
06		*										*	6	0.71
09		*											9	0.15
12		*										*	12	
15				*								*	24	
18				*								*		
21														
Avg		*		*								*		
	N = 0.4				BLOWING DUST (visibility <11 km)									
00													1	1.00
03		*										*	3	0.66
06		*										*	6	0.55
09		*											9	0.11
12		*										*	12	
15				*							*	*	24	
18				*								*		
21														
Avg		*		*							*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 56

OCCURRENCE OF DUST - TOMTOR, CENTRAL UPLAND REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 52

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
N = 0					DUST STORMS (visibility <1 km)									
01													1	
04													3	
07													6	
10													9	
13						NONE REPORTED							12	
16													24	
19														
22														
Avg														
N = 0.5					BLOWING DUST (visibility <11 km)									
01													1	1.00
04													3	0.30
07													6	0.11
10					*								9	
13					*							*	12	
16								*					24	
19														
22														
Avg					*			*				*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 57

OCCURRENCE OF DUST - TUNGOKOCHEN, CENTRAL UPLAND REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 53

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
N = 0.3					DUST STORMS (visibility <1 km)									
02							*						1	1.00
05							*						3	0.47
08							*						6	0.33
11							*						9	
14				*									12	
17													24	
20														
23														
Avg				*			*							
N = 0.8					BLOWING DUST (visibility <11 km)									
02							*						1	1.00
05							*						3	0.56
08							*						6	0.38
11							*						9	0.06
14				1	*								12	
17				*	*								24	
20					*		*							
23							*							
Avg				*	*		*							

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 58

OCCURRENCE OF DUST - TUOY KHAYA, CENTRAL UPLAND REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 54

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
N = 0	DUST STORMS (visibility <1 km)													
01													1	
04													3	
07													6	
10	NONE REPORTED												9	
13													12	
16													24	
19														
22														
Avg														
N = 0.05	BLOWING DUST (visibility <11 km)													
01													1	1.00
04													3	1.00
07													6	
10											*		9	
13													12	
16													24	
19														
22														
Avg											*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 59

OCCURRENCE OF DUST - TURA, CENTRAL UPLAND REGION, SIBERIA (Jul 57 - Dec 68)

FIGURE 3 STATION 55

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
N = 0	DUST STORMS (visibility <1 km)													
01														
04														
07														
10														
13														
16	NONE REPORTED													
19														
22														
Avg														
N = 0	BLOWING DUST (visibility <11 km)													
01														
04														
07														
10														
13														
16	NONE REPORTED													
19														
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 60

OCCURRENCE OF DUST - VANAVARA, CENTRAL UPLAND REGION, SIBERIA (Jul 57 - Dec 68)

FIGURE 3 STATION 56

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
N = 0	DUST STORMS (visibility <1 km)													
01														
04														
07														
10														
13	NONE REPORTED													
16														
19														
22														
Avg														
N = 0	BLOWING DUST (visibility <11 km)													
01														
04														
07														
10														
13														
16	NONE REPORTED													
19														
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 61

OCCURRENCE OF DUST - VERKHOYANSK, CENTRAL UPLAND REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 57

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	N = 0.08				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	0.63
06													6	0.63
09													9	
12													12	
15						*							24	
18						*								
21														
Avg						*								
	N = 0.8				BLOWING DUST (visibility <11 km)									
00													1	1.00
03							*						3	0.25
06													6	0.06
09													9	
12													12	
15						*							24	
18		*				*								
21														
Avg		*				*	*							

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 62

OCCURRENCE OF DUST - VILYUYSK, CENTRAL UPLAND REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 58

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0						DUST STORMS (visibility <1 km)							
02													1	
05													3	
08													6	
11							NONE REPORTED						9	
14													12	
17													24	
20														
23														
Avg														
	N = 0.05						BLOWING DUST (visibility <11 km)							
02													1	1.00
05													3	1.00
08													6	
11													9	
14							*						12	
17													24	
20														
23														
Avg							*							

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 63

OCCURRENCE OF DUST - YAKUTSK, CENTRAL UPLAND REGION, SIBERIA (Feb 53 - Dec 68)

FIGURE 3 STATION 59

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 2				BLOWING DUST (visibility <11 km)									
00													1	1.00
03								*					3	0.30
06							*						6	0.10
09							*						9	
12													12	
15					*		*	*					24	
18							*	*						
21							*							
Avg					*		*	*						

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 64

OCCURRENCE OF DUST - YESSEY, CENTRAL UPLAND REGION, SIBERIA (Jul 57 - Dec 68)

FIGURE 3 STATION 60

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
N = 0	DUST STORMS (visibility <1 km)													
01														
04														
07														
10														
13	NONE REPORTED													
16														
19														
22														
Avg														
N = 0	BLOWING DUST (visibility <11 km)													
01														
04														
07														
10														
13	NONE REPORTED													
16														
19														
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 65

OCCURRENCE OF DUST - ZHIGANSK, CENTRAL UPLAND REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 61

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.05				DUST STORMS (visibility <1 km)									
02													1	1.00
05													3	1.00
08													6	
11													9	
14													12	
17													24	
20	*													
23														
Avg	*													
	N = 1				BLOWING DUST (visibility <11 km)									
02			*										1	1.00
05			*										3	0.22
08													6	0.05
11													9	
14					*		*		*				12	
17													24	
20	*													
23														
Avg	*		*		*		*		*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 66

OCCURRENCE OF DUST - ALDAN, FAR EAST REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 62

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0.2				DUST STORMS (visibility <1 km)									
02													1	1.00
05													3	0.42
08													6	0.21
11													9	
14													12	
17						*							24	
20						*			*					
23														
Avg						*			*					
	N = 0.3				BLOWING DUST (visibility <11 km)									
02													1	1.00
05													3	0.47
08								*					6	0.33
11								*					9	
14													12	
17						*							24	
20						*			*					
23														
Avg						*		*	*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 67

OCCURRENCE OF DUST - AYAN, FAR EAST REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 63

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0.1				DUST STORMS (visibility <1 km)									
00													1	1.00
03					*								3	1.00
06													6	
09													9	
12													12	
15												*	24	
18														
21														
Avg					*							*		
	N = 0.5				BLOWING DUST (visibility <11 km)									
00													1	1.00
03					*								3	0.31
06													6	0.10
09							*						9	
12							*						12	
15												*	24	
18														
21														
Avg					*		*					*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 68

OCCURRENCE OF DUST - BIKIN, FAR EAST REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 64

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	N = 0					DUST STORMS (visibility <1 km)								
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 1					BLOWING DUST (visibility <11 km)								
00								*	*				1	1.00
03				*					*				3	0.37
06									*				6	0.17
09													9	
12													12	
15			*	*		*							24	
18				*										
21			*					*	*		*			
Avg			*	*		*		*	*		*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 69

OCCURRENCE OF DUST - BLAGOVESHCHENSK, FAR EAST REGION, SIBERIA (Aug 47 - Dec 68)

FIGURE 3 STATION 65

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02													1	
05													3	
08													6	
11						NONE REPORTED							9	
14													12	
17													24	
20														
23														
Avg														
	N = 0.7				BLOWING DUST (visibility <11 km)									
02													1	1.00
05													3	0.49
08				*									6	0.19
11				*	*			*					9	0.07
14				*	*				*				12	0.07
17				*									24	
20														
23														
Avg				*	*			*	*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 70

OCCURRENCE OF DUST - EKIMCHAN, FAR EAST REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 66

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0.7				DUST STORMS (visibility <1 km)									
00						*							1	1.00
03									*				3	0.34
06								*	*				6	0.14
09									*				9	
12													12	
15												*	24	
18														
21						*								
Avg						*		*	*			*		
	N = 1				BLOWING DUST (visibility <11 km)									
00						*							1	1.00
03									*			*	3	0.33
06								*	*				6	0.12
09									*	*	*		9	
12										*			12	
15												*	24	
18														
21						*								
Avg						*		*	*	*	*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 71

OCCURRENCE OF DUST - GROSSEVICHI, FAR EAST REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 67

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0.3				DUST STORMS (visibility <1 km)									
00													1	1.00
03			*							*			3	0.47
06			*										6	0.33
09													9	
12													12	
15								*					24	
18								*						
21														
Avg			*					*		*				
	N = 0.5				BLOWING DUST (visibility <11 km)									
00													1	1.00
03			*							*			3	0.40
06			*										6	0.21
09													9	
12								*					12	
15								*					24	
18								*						
21														
Avg			*					*		*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 72

OCCURRENCE OF DUST - GUGA, FAR EAST REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 68

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09							NONE REPORTED						9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.2				BLOWING DUST (visibility <11 km)									
00													1	1.00
03													3	0.42
06													6	0.21
09				*					*				9	
12									*				12	
15													24	
18														
21														
Avg				*					*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.55

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

AD-A040 581 ARMY ELECTRONICS COMMAND WHITE SANDS MISSILE RANGE N--ETC F/G 4/1
BOUNDARY LAYER DUST OCCURRENCE, III, ATMOSPHERIC DUST OVER RUSS--ETC(U)
MAY 77 B D HINDS, G B HOIDALE

UNCLASSIFIED ECOM-DR-77-2 NL

2 OF 5
ADA040581

2 OF 5

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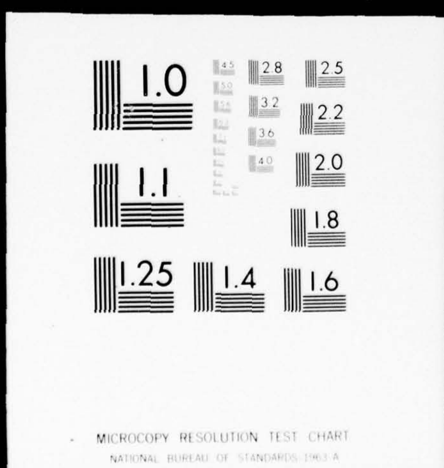

TABLE 73

OCCURRENCE OF DUST - IL'INSKIY, FAR EAST REGION, SIBERIA (Feb 53 - Dec 68)

FIGURE 3 STATION 69

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.6				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	0.31
06													6	0.10
09			*	*									9	
12				*									12	
15													24	
18														
21					*									
Avg			*	*	*									
	N = 0.9				BLOWING DUST (visibility <11 km)									
00													1	1.00
03									*				3	0.51
06									*				6	0.36
09			*	*			*			*			9	
12				*			*			*			12	
15													24	
18														
21					*									
Avg			*	*	*		*		*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 74

OCCURRENCE OF DUST - KAMEN RYBOLOV, FAR EAST REGION, SIBERIA (Feb 53 - Dec 68)

FIGURE 3 STATION 70

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.6				BLOWING DUST (visibility <11 km)									
00			*										1	1.00
03													3	0.40
06													6	0.21
09				*									9	
12				*									12	
15													24	
18	*		*											
21			*											
Avg	*		*	*										

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 75

OCCURRENCE OF DUST - KHABAROVSK, FAR EAST REGION, SIBERIA (Aug 47 - Dec 68)

FIGURE 3 STATION 71

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.1				DUST STORMS (visibility <1 km)									
00													1	1.00
03								*					3	0.60
06								*					6	0.60
09							*						9	
12							*						12	
15													24	
18														
21														
Avg							*	*						
	N = 0.9				BLOWING DUST (visibility <11 km)									
00					*								1	1.00
03							*	*				*	3	0.48
06							*	*				*	6	0.32
09			*				*						9	
12				*			*						12	
15					*								24	
18					*									
21				*	*									
Avg			*	*	*		*	*				*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 76

OCCURRENCE OF DUST - KONDON, FAR EAST REGION, SIBERIA (Dec 53 - Dec 68)

FIGURE 3 STATION 72

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.3				BLOWING DUST (visibility <11 km)									
00													1	1.00
03													3	0.39
06													6	0.21
09								*					9	
12								*					12	
15					*								24	
18														
21														
Avg					*			*						

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 77

OCCURRENCE OF DUST - KUMARA, FAR EAST REGION, SIBERIA (Aug 47 - Dec 68)

FIGURE 3 STATION 73

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02													1	
05													3	
08													6	
11						NONE REPORTED							9	
14													12	
17													24	
20														
23														
Avg														
	N = 0.05				BLOWING DUST (visibility <11 km)									
02													1	1.00
05													3	1.00
08													6	
11													9	
14				*									12	
17													24	
20														
23														
Avg				*										

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 78

OCCURRENCE OF DUST - NOGLIKI, FAR EAST REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 74

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
N = 0.3	DUST STORMS (visibility <1 km)													
01					*								1	1.00
04													3	0.49
07										*			6	0.31
10							*						9	
13							*						12	
16													24	
19														
22					*									
Avg					*		*			*				
N = 0.7	BLOWING DUST (visibility <11 km)													
01					*				*		*		1	1.00
04									*				3	0.48
07										*			6	0.32
10							*				*		9	
13							*						12	
16													24	
19														
22					*						*			
Avg					*		*		*	*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 79

OCCURRENCE OF DUST - OKHOTSK, FAR EAST REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 75

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
						Diurnal Variation by Month (%)								
N = 0.6						DUST STORMS (visibility <1 km)								
01													1	1.00
04					*		*						3	0.31
07			*										6	0.10
10							*						9	
13													12	
16													24	
19														
22														
Avg			*		*		*							
N = 1						BLOWING DUST (visibility <11 km)								
01							*						1	1.00
04					*					*			3	0.33
07			*	*			*			*			6	0.13
10				*			*						9	
13													12	
16													24	
19														
22							*							
Avg			*	*	*		*			*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 80

OCCURRENCE OF DUST - PORONAYSK, FAR EAST REGION, SIBERIA (Feb 53 - Dec 68)

FIGURE 3 STATION 76

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
N = 0					DUST STORMS (visibility <1 km)									
01													1	
04													3	
07													6	
10							NONE REPORTED						9	
13													12	
16													24	
19														
22														
Avg														
N = 1					BLOWING DUST (visibility <11 km)									
01						*							1	1.00
04								*					3	0.25
07							*	*					6	0.06
10													9	
13													12	
16													24	
19	*													
22														
Avg	*					*	*	*						

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 81

OCCURRENCE OF DUST - POSET, FAR EAST REGION, SIBERIA (Jan 56 - Dec 68)

FIGURE 3 STATION 77

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.2				BLOWING DUST (visibility <11 km)									
00				*									1	1.00
03									*				3	0.79
06													6	0.42
09													9	0.42
12													12	0.42
15				*									24	
18				*										
21				*										
Avg				*					*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 82

OCCURRENCE OF DUST - SUTUR, FAR EAST REGION, SIBERIA (Oct 53 - Dec 68)

FIGURE 3 STATION 78

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0.1				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	0.66
06													6	0.66
09								*					9	
12								*					12	
15													24	
18														
21														
Avg								*						
	N = 0.1				BLOWING DUST (visibility <11 km)									
00													1	1.00
03													3	0.66
06													6	0.66
09								*					9	
12								*					12	
15													24	
18														
21														
Avg								*						

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 83

OCCURRENCE OF DUST - TERNEY, FAR EAST REGION, SIBERIA (Feb 53 - Dec 68)

FIGURE 3 STATION 79

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0			DUST STORMS (visibility <1 km)										
00													1	
03													3	
06							NONE REPORTED						6	
09													9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.1			BLOWING DUST (visibility <11 km)										
00													1	1.00
03													3	0.64
06													6	0.64
09							*						9	
12							*						12	
15													24	
18														
21														
Avg							*							

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 84

OCCURRENCE OF DUST - TROITSKOYE, FAR EAST REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 80

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0					DUST STORMS (visibility <1 km)								
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 2					BLOWING DUST (visibility <11 km)								
00													1	1.00
03													3	0.19
06													6	0.03
09													9	
12													12	
15							*	*		*	*		24	
18						*				*				
21														
Avg						*	*	*		*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 85

OCCURRENCE OF DUST - VERKHNYAYA, FAR EAST REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 81

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	N = 0					DUST STORMS (visibility <1 km)								
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.5					BLOWING DUST (visibility <11 km)								
00							*						1	1.00
03													3	0.31
06													6	0.10
09													9	
12								*					12	
15													24	
18						*								
21							*							
Avg						*	*	*						

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 86

OCCURRENCE OF DUST - VLADIVOSTOK, FAR EAST REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 82

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.05				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	1.00
06													6	
09													9	
12													12	
15													24	
18														
21							*							
Avg							*							
	N = 0.4				BLOWING DUST (visibility <11 km)									
00							*						1	1.00
03													3	0.55
06													6	0.43
09								*			*		9	
12								*			*		12	
15													24	
18				*										
21				*			*							
Avg				*			*	*			*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 87

OCCURRENCE OF DUST - YEKATERINO NIKOLSKYE, FAR EAST REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 83

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0.5				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	0.29
06													6	0.11
09													9	
12													12	
15									*			*	24	
18						*			*					
21														
Avg						*			*			*		
	N = 1				BLOWING DUST (visibility <11 km)									
00							*						1	1.00
03													3	0.47
06													6	0.25
09					*								9	0.03
12			*	*	1								12	
15			*	1	*	*			*			*	24	
18				1	*	*			*					
21														
Avg			*	*	*	*	*		*			*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 88

OCCURRENCE OF DUST - YELIZAVETY, MYS, FAR EAST REGION, SIBERIA (Mar 56 - Dec 68)

FIGURE 3 STATION 84

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
N = 0.1					DUST STORMS (visibility <1 km)									
01													1	1.00
04													3	0.67
07													6	0.67
10													9	
13													12	
16					*								24	
19					*									
22														
Avg					*									
N = 0.8					BLOWING DUST (visibility <11 km)									
01						*							1	1.00
04													3	0.39
07													6	0.20
10						*							9	
13													12	
16					*								24	
19					*									
22						*								
Avg					*	*								

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 89

OCCURRENCE OF DUST - ZEYA, FAR EAST REGION, SIBERIA (Jan 48 - Dec 68)

FIGURE 3 STATION 85

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0.2				DUST STORMS (visibility <1 km)									
02									*				1	1.00
05									*				3	0.42
08													6	0.20
11													9	
14				*									12	
17													24	
20														
23														
Avg				*					*					
	N = 1				BLOWING DUST (visibility <11 km)									
02								*	*				1	1.00
05								*	*				3	0.30
08													6	0.11
11													9	
14				*	*		*						12	
17													24	
20														
23														
Avg				*	*		*	*	*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 90

OCCURRENCE OF DUST - AKBAYTAL, KAZAKH, SOVIET CENTRAL ASIA (Feb 57 - Dec 68)

FIGURE 4 STATION 1

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 1				DUST STORMS (visibility <1 km)									
01										*			1	1.00
04				*									3	0.48
07													6	0.32
10	*					*							9	
13	*					*							12	
16									*				24	
19							*		*					
22										*				
Avg	*			*		*	*		*	*				
	N = 10				BLOWING DUST (visibility <11 km)									
01	*			*	*	1		*		*	*	*	1	1.00
04	*			1		*		*			*		3	0.65
07	*			*				*			*		6	0.49
10	*	1	*	*	*	1	2		1	*	1		9	0.13
13	*		*	*	*	2	2	*	1	*	1		12	0.11
16	1	1	1	2	2	1	2	2	2	1	1	*	24	0.01
19	1	*	1	2	1	1	3	2	2	1	1	*		
22	*			*	*	1		*		*		*		
Avg	*	*	*	1	1	1	1	1	1	*	1	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 91

OCCURRENCE OF DUST - AK KUDUK, KAZAKH, SOVIET CENTRAL ASIA (Jul 57 - Dec 68)

FIGURE 4 STATION 2

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	N = 0.6				DUST STORMS (visibility <1 km)									
01				*									1	1.00
04													3	0.64
07													6	0.64
10													9	
13			*										12	
16			1	*									24	
19			*	*										
22				*										
Avg			*	*										
	N = 4				BLOWING DUST (visibility <11 km)									
01		*		*									1	1.00
04		*											3	0.61
07		*											6	0.41
10			1										9	0.11
13		*	1	1					*				12	0.09
16		*	2	2			*			*	1		24	
19		*	2	2		*	1			*	1			
22		*	1	*										
Avg		*	1	1		*	*		*	*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 92

OCCURRENCE OF DUST - AKTYUBINSK, KAZAKH, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 3

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0.8					DUST STORMS (visibility <1 km)								
01													1	1.00
04	*												3	0.42
07	*												6	0.24
10		*						*					9	
13		*			*			*		*			12	
16						*							24	
19														
22														
Avg	*	*			*	*		*		*				
	N = 8					BLOWING DUST (visibility <11 km)								
01				*	1	*	*						1	1.00
04	*			*	*	*	*		*				3	0.64
07	*						*						6	0.42
10		*		2	3	1	*	1	1	1		*	9	0.15
13		*		2	3	2	1	2	*	1		*	12	0.07
16	*			1	3	2	1	2	1	1			24	
19	*			1	1	1	1	1	*	1				
22				*	*	*	*		*	*				
Avg	*	*		1	1	1	1	1	*	*		*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 93

OCCURRENCE OF DUST - AMANGEL'DY, KAZAKH, SOVIET CENTRAL ASIA (Feb 53 - Dec 68)

FIGURE 4 STATION 4

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
N = 3				DUST STORMS (visibility <1 km)										
01													1	1.00
04									*				3	0.41
07													6	0.17
10				1	*		*			*			9	0.02
13				*	*		*	*	*	*			12	
16				*	*		*	*					24	
19					*		1	1	*					
22								*						
Avg				*	*		*	*	*	*				
N = 5				BLOWING DUST (visibility <11 km)										
01					1	*			*				1	1.00
04					*				*				3	0.62
07					1								6	0.43
10		*		1	1	1	*	*	1	1			9	0.12
13		*		1	*	1	1	*	1	1	*		12	0.06
16				1	1	1	1	1	*	*			24	
19					1	1	1	1	*	*				
22					*	*		*						
Avg		*		*	1	1	*	*	1	*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 94

OCCURRENCE OF DUST - ATBASAR, KAZAKH, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 5

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0.7				DUST STORMS (visibility <1 km)									
02													1	1.00
05				*									3	0.59
08													6	0.45
11		*			*					*			9	0.06
14		*		*	*					*			12	
17				*	*			*					24	
20				*	*	*		*						
23														
Avg		*		*	*	*		*		*				
	N = 4				BLOWING DUST (visibility <11 km)									
02	*	*		1						*			1	1.00
05				*					*	*			3	0.59
08				*					*	*			6	0.40
11		*		1	1					*		*	9	0.09
14		*		1	2			*	*	1		*	12	0.06
17		*		1	2			*	*	*			24	0.01
20				1	2	*		*	*	*		*		
23	*	*		1						*				
Avg	*	*		1	1	*		*	*	*		*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 95

OCCURRENCE OF DUST - AYAGUZ, KAZAKH, SOVIET CENTRAL ASIA (Jul 57 - Dec 68)

FIGURE 4 STATION 6

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	Diurnal Variation by Month (%)												Duration Factor	
	N = 0				DUST STORMS (visibility <1 km)									
02													1	
05													3	
08						NONE REPORTED							6	
11													9	
14													12	
17													24	
20														
23														
Avg														
	N = 3				BLOWING DUST (visibility <11 km)									
02													1	1.00
05													3	0.28
08									*				6	0.08
11									*				9	
14							1						12	
17					*	*				*			24	
20				1	*					*				
23						*				*				
Avg				*	*	*	*		*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 96

OCCURRENCE OF DUST - BETPAK, KAZAKH, SOVIET CENTRAL ASIA (Jul 57 - Dec 68)

FIGURE 4 STATION 7

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02													1	
05													3	
08					NONE REPORTED								6	
11													9	
14													12	
17													24	
20														
23														
Avg														
	N = 0.09				BLOWING DUST (visibility <11 km)									
02													1	1.00
05													3	1.00
08													6	
11													9	
14													12	
17													24	
20							*							
23														
Avg							*							

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 97

OCCURRENCE OF DUST - KARA KUM, KAZAKH, SOVIET CENTRAL ASIA (Jul 57 - Dec 68)

FIGURE 4 STATION 8

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	N = 0.7				DUST STORMS (visibility <1 km)									
01										*			1	1.00
04										*			3	0.66
07													6	0.52
10						*					*		9	0.13
13						*					*		12	0.13
16							*			1			24	
19										1				
22										*				
Avg						*	*			*	*			
	N = 2				BLOWING DUST (visibility <11 km)									
01					*					*			1	1.00
04					*					*			3	0.73
07					*								6	0.51
10			*		*	*	*		*		*		9	0.28
13			*	*	*	*	*		*	*	*		12	0.12
16			*	*	*	*	*		*	1	*		24	
19					*					1				
22										*				
Avg			*	*	*	*	*		*	*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 98

OCCURRENCE OF DUST - KAYNAR, KAZAKH, SOVIET CENTRAL ASIA (Jul 57 - Dec 68)

FIGURE 4 STATION 9

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02													1	
05													3	
08						NONE REPORTED							6	
11													9	
14													12	
17													24	
20														
23														
Avg														
	N = 0.09				BLOWING DUST (visibility <11 km)									
02													1	1.00
05													3	1.00
08													6	
11													9	
14												*	12	
17													24	
20														
23														
Avg												*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals *duration factor times diurnal variation by month.*

TABLE 99

OCCURRENCE OF DUST - KOZHASAY, KAZAKH, SOVIET CENTRAL ASIA (Feb 53 - Dec 68)

FIGURE 4 STATION 10

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
01													1	
04													3	
07													6	
10						NONE REPORTED							9	
13													12	
16													24	
19														
22														
Avg														
	N = 0.7				BLOWING DUST (visibility <11 km)									
01				*									1	1.00
04	*												3	0.44
07													6	0.27
10													9	
13													12	
16				*			*						24	
19				*			*							
22				*										
Avg	*			*			*							

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 100

OCCURRENCE OF DUST - KUSTANAY, KAZAKH, SOVIET CENTRAL ASIA (Feb 46 - Dec 68)

FIGURE 4 STATION 11

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	N = 0.5				DUST STORMS (visibility <1 km)									
01													1	1.00
04	*												3	0.60
07	*												6	0.42
10				*				*					9	0.08
13				*	*			*	*				12	0.08
16						*		*					24	
19						*		*						
22														
Avg	*			*	*	*		*	*					
	N = 7				BLOWING DUST (visibility <11 km)									
01					*			*		*			1	1.00
04	*			*				*				*	3	0.62
07	*			*				*				*	6	0.47
10			*	1	2	1	1	1	1	*			9	0.11
13			*	2	4	1	1	1	1	*			12	0.05
16				1	3	1	1	1	1	*			24	
19				1	3	1	1	*	1					
22				*	1	*		*		*				
Avg	*		*	1	2	*	*	*	1	*		*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 101

OCCURRENCE OF DUST - MOGITA TOKUBEY, KAZAKH, SOVIET CENTRAL ASIA (Jan 59 - Dec 68)

FIGURE 4 STATION 12

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0			DUST STORMS (visibility <1 km)										
02													1	
05													3	
08						NONE REPORTED							6	
11													9	
14													12	
17													24	
20														
23														
Avg														
	N = 0.1			BLOWING DUST (visibility <11 km)										
02													1	1.00
05													3	1.00
08													6	
11													9	
14									*				12	
17													24	
20														
23														
Avg									*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 102

OCCURRENCE OF DUST - PAVLODAR, KAZAKH, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 13

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 2				DUST STORMS (visibility <1 km)									
02								*					1	1.00
05					*								3	0.55
08													6	0.37
11					*	*	*		*	1	*		9	0.05
14					1	*	*		*	1	*		12	0.03
17				*	1	*			*	*	*		24	
20				*	1	*			*		*			
23					*			*						
Avg				*	*	*	*	*	*	*	*			
	N = 10				BLOWING DUST (visibility <11 km)									
02					1	*		*	*	*			1	1.00
05					1	*				*			3	0.62
08				*	1				*	*			6	0.45
11	*			3	4		1		2	1	*		9	0.12
14	*			2	4	1	1		2	1	*		12	0.07
17	*			1	4	1	1	*	1	*	1		24	
20	*			*	4	2	*	*	1	*	1			
23					*	*		*	*	*				
Avg	*			1	2	1	*	*	1	*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 103

OCCURRENCE OF DUST - PETROPAVLOVSK, KAZAKH, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 14

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0.2					DUST STORMS (visibility <1 km)								
02													1	1.00
05													3	0.42
08													6	0.21
11						*							9	
14													12	
17	*												24	
20	*													
23														
Avg	*					*								
	N = 2					BLOWING DUST (visibility <11 km)								
02					*						*		1	1.00
05								*			*	*	3	0.66
08								*				*	6	0.55
11			*	*	1	*	*					*	9	0.14
14			*	1	1	*	*					*	12	0.06
17	*		*	1	1	*					*		24	
20	*			*	1	*					*			
23					*									
Avg	*		*	*	*	*	*	*			*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 104

OCCURRENCE OF DUST - SEMIPALATINSK, KAZAKH, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 15

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
N = 1				DUST STORMS (visibility <1 km)										
02											*	*	1	1.00
05												*	3	0.63
08												*	6	0.58
11				*	*			*	*			*	9	0.05
14				*	*				*			*	12	0.05
17				*	*	*	*		*				24	
20				*	*	*	*		*					
23											*	*		
Avg				*	*	*	*	*	*		*	*		
N = 6				BLOWING DUST (visibility <11 km)										
02			*		*		*				*	*	1	1.00
05	*					*		*		*	*	*	3	0.58
08	*				*	*		*	*	*	*	*	6	0.40
11				1	1	1		1	*	1		1	9	0.08
14				1	1	1	*	1	*	1		1	12	0.04
17	*		*	1	1	1	1	1	1	*	*	*	24	
20	*		*	1	1	1	1		*	*	*	*		
23			*		1		*	*	*		*	*		
Avg	*		*	*	1	*	*	*	*	*	*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 105

OCCURRENCE OF DUST - UCH-ARAL, KAZAKH, SOVIET CENTRAL ASIA (Feb 53 - Dec 68)

FIGURE 4 STATION 16

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
N = 0.8	DUST STORMS (visibility <1 km)													
02													1	1.00
05				*									3	0.49
08				*								*	6	0.32
11								*				*	9	
14								*					12	
17					*		*	*					24	
20							*							
23														
Avg				*	*		*	*				*		
N = 2	BLOWING DUST (visibility <11 km)													
02					*								1	1.00
05				*					*				3	0.56
08				*	*							*	6	0.35
11								*	*	*		*	9	0.07
14							*	*	*	*		*	12	0.03
17					*		*	*	*			*	24	
20									*			*		
23					*									
Avg				*	*		*	*	*	*		*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 106

OCCURRENCE OF DUST - ZLIKHA, KAZAKH, SOVIET CENTRAL ASIA (Feb 53 - Dec 68)

FIGURE 4 STATION 17

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.8				DUST STORMS (visibility <1 km)									
01													1	1.00
04												*	3	0.66
07							*					*	6	0.50
10							*	1		*			9	0.16
13					*			*		*			12	0.08
16			*		*					*			24	
19			*		*	*				*				
22														
Avg			*		*	*	*	*		*		*		
	N = 5				BLOWING DUST (visibility <11 km)									
01			*	*				*					1	1.00
04				*				*				*	3	0.55
07				*	*		*	1				*	6	0.28
10	*		*	1	*		*	1	1	1			9	0.09
13	*	*	*	1	*	*	*	2	1	1		*	12	0.09
16	*		1	*	*	1	1	1	1	*			24	0.01
19	*		1	*	*	*	1	*		*				
22			*					*						
Avg	*	*	*	*	*	*	*	*	*	*		*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 107

OCCURRENCE OF DUST - AKBAYTAL, TADZHIK, SOVIET CENTRAL ASIA (Jul 57 - Dec 68)

FIGURE 4 STATION 18

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	Diurnal Variation by Month (%)												Duration Factor	
	N = 0.1				DUST STORMS (visibility <1 km)									
02													1	1.00
05													3	0.64
08													6	0.64
11					*								9	
14					1								12	
17													24	
20														
23														
Avg					*									
	N = 0.1				BLOWING DUST (visibility <11 km)									
02													1	1.00
05													3	0.64
08													6	0.64
11					*								9	
14					1								12	
17													24	
20														
23														
Avg					*									

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 108

OCCURRENCE OF DUST - KHOROG, TADZHIK, SOVIET CENTRAL ASIA (Oct 57 - Dec 68)

FIGURE 4 STATION 19

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02													1	
05													3	
08						NONE REPORTED							6	
11													9	
14													12	
17													24	
20														
23														
Avg														
	N = 0.3				BLOWING DUST (visibility <11 km)									
02			*					*					1	1.00
05			*										3	0.62
08													6	0.62
11													9	
14													12	
17													24	
20														
23								*						
Avg			*					*						

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 109

OCCURRENCE OF DUST - EKEDZHE, TURKMEN, SOVIET CENTRAL ASIA (Jan 59 - Dec 68)

FIGURE 4 STATION 20

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 1				DUST STORMS (visibility <1 km)									
01								1					1	1.00
04							*						3	0.59
07				1			1						6	0.45
10			*	1									9	0.07
13		1	*										12	
16		*				*			*				24	
19		1							1					
22								*	1					
Avg		*	*	*		*	*	*	*					
	N = 8				BLOWING DUST (visibility <11 km)									
01		1	1	1	1	1		2	1		1		1	1.00
04			*			*	*	*					3	0.65
07			*	1			1	*					6	0.52
10		1	1	2				*	*				9	0.14
13		1	2	1					1	1			12	0.08
16	*	1	2	*	1	1		*	2	*	*		24	
19	1	2	2	1	1	1	1	1	2	1	1			
22	1	1	1	*	*	1		1	2		1			
Avg	*	1	1	1	*	1	*	1	1	*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 110

OCCURRENCE OF DUST - KRASNOVODSK, TURKMEN, SOVIET CENTRAL ASIA (Jul 57 - Dec 68)

FIGURE 4 STATION 21

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	Diurnal Variation by Month (%)												Duration Factor	
	N = 4				DUST STORMS (visibility <1 km)									
01					1								1	1.00
04		*			*				*	*			3	0.58
07		*			*				*	*			6	0.41
10			1		*	*		1	1	*			9	0.08
13			1		*	1		1	1	*	*		12	0.06
16		*	*	1	*	1	1	1	1				24	
19			*	*	*	1		*	1					
22					1									
Avg		*	*	*	*	*	*	*	1	*	*			
	N = 19				BLOWING DUST (visibility <11 km)									
01	1	*		*	1	*		1	1		*		1	1.00
04	*	1	*	*	1			1	2	*	*	*	3	0.68
07	*	1	*		1			1	2	*		1	6	0.55
10	*	1	2	1	3	2	1	4	4	1	1	1	9	0.18
13	*	1	2	1	3	1	1	4	3	2	1	*	12	0.11
16	1	1	2	3	6	3	4	3	4	1	*	*	24	
19	2	*	2	1	5	3	3	2	4	1	*	*		
22	1	*		*	1	1		1	2	*	*			
Avg	1	1	1	1	3	1	1	2	3	1	*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 111

OCCURRENCE OF DUST - CHIMBAY, UZBEK, SOVIET CENTRAL ASIA (Jan 55 - Dec 68)

FIGURE 4 STATION 22

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 1				DUST STORMS (visibility <1 km)									
01													1	1.00
04													3	0.50
07													6	0.36
10													9	
13				*									12	
16	*	*	1			*							24	
19	*		1			*								
22														
Avg	*	*	*	*		*								
	N = 11				BLOWING DUST (visibility <11 km)									
01		*	1	*	*	1		*	1		1		1	1.00
04		*		*	*				1		1	*	3	0.66
07		*		*	*				1		*	*	6	0.55
10			1	2	2	1		*	1				9	0.14
13			1	2	2	1		1	1				12	0.11
16	1	1	2	3	3	2	1	2	3	1	1	*	24	0.01
19	1	1	3	3	3	2	1	2	3	1	1			
22		*	1	1	*	1		*	1	*	1			
Avg	*	*	1	2	1	1	*	1	1	*	*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 112

OCCURRENCE OF DUST - NURATA, UZBEK, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 23

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
						Diurnal Variation by Month (%)								
N = 1					DUST STORMS (visibility <1 km)									
01					*		*						1	1.00
04				*									3	0.40
07													6	0.20
10		*										*	9	
13			*								*		12	
16			*								*	*	24	
19			*											
22			*		*		*							
Avg		*	*	*	*		*				*	*		
N = 4					BLOWING DUST (visibility <11 km)									
01		*			*	*	1	*				*	1	1.00
04		1		*		*	*						3	0.53
07		1				*	*			*			6	0.31
10	*	*		*		*	*	*	*	1		*	9	0.05
13	*		*	*		*	1	*	*	1	*	1	12	0.04
16	*	*	*		1	*	*	*		*	1	1	24	
19		*	*		1	*	*	*		1	1	*		
22		*	*		*	*	1	*	*		*	*		
Avg	*	*	*	*	*	*	*	*	*	*	*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 113

OCCURRENCE OF DUST - ABAKAN, RSFSR, SOVIET CENTRAL ASIA (Jul 57 - Dec 68)

FIGURE 4 STATION 24

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 2				DUST STORMS (visibility <1 km)									
00													1	1.00
03				*									3	0.36
06													6	0.15
09													9	
12					1						1		12	
15					1								24	
18					*				*					
21					*									
Avg				*	*				*		*			
	N = 7				BLOWING DUST (visibility <11 km)									
00				1	1								1	1.00
03			*	*	*								3	0.56
06			*		1								6	0.27
09			*		1								9	0.10
12			*	1	4	*		1			2		12	0.05
15			*	1	2	*		*		*	1		24	
18			*	1	2	1			1					
21				*	2	*	*		*					
Avg			*	1	2	*	*	*	*	*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 114

OCCURRENCE OF DUST - ADAMOVKA, RSFSR, SOVIET CENTRAL ASIA (Oct 46 - Dec 68)

FIGURE 4 STATION 25

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0.4				DUST STORMS (visibility <1 km)									
01					*								1	1.00
04													3	0.31
07													6	0.11
10													9	
13													12	
16					*	*							24	
19														
22					*									
Avg					*	*								
	N = 2				BLOWING DUST (visibility <11 km)									
01				*	*				*				1	1.00
04				*					*				3	0.60
07									*				6	0.30
10	*			*	*				*				9	0.13
13				1	*	*			1	*			12	0.05
16				1	*	*		*		*			24	
19				1	*				*	*				
22				*	*				*					
Avg	*				*	*		*	*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 115

OCCURRENCE OF DUST - ALEKSANDROVSKOYE, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 26

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
01													1	
04													3	
07													6	
10						NONE REPORTED							9	
13													12	
16													24	
19														
22														
Avg														
	N = 0.09				BLOWING DUST (visibility <11 km)									
01			*										1	1.00
04													3	1.00
07													6	
10													9	
13													12	
16													24	
19														
22														
Avg			*											

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 116

OCCURRENCE OF DUST - AMDERMA, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 27

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.08				DUST STORMS (visibility <1 km)									
01													1	1.00
04	*												3	0.63
07	*												6	0.63
10													9	
13													12	
16													24	
19														
22														
Avg	*													
	N = 0.4				BLOWING DUST (visibility <11 km)									
01												*	1	1.00
04	*		*							*			3	0.63
07	*		*							*			6	0.63
10													9	
13													12	
16													24	
19														
22												*		
Avg	*		*							*		*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 117

OCCURRENCE OF DUST - BARABINSK, RSFSR, SOVIET CENTRAL ASIA (Aug 47 - Dec 68)

FIGURE 4 STATION 28

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.1				DUST STORMS (visibility <1 km)									
02				*									1	1.00
05													3	0.82
08													6	0.45
11													9	0.45
14													12	
17				*									24	
20				*										
23				*										
Avg				*										
	N = 0.8				BLOWING DUST (visibility <11 km)									
02				*				*					1	1.00
05			*	*						*			3	0.68
08			*	*						*			6	0.57
11			*	*	*	*				*			9	0.17
14					*	*							12	0.11
17				*	*	*							24	
20				*	*	*								
23				*				*						
Avg			*	*	*	*		*		*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 118

OCCURRENCE OF DUST - BARNAUL, RSFSR, SOVIET CENTRAL ASIA (Aug 47 - Dec 68)

FIGURE 4 STATION 29

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.7				DUST STORMS (visibility <1 km)									
00	*	*											1	1.00
03	*	*											3	0.63
06	*												6	0.44
09											*		9	0.12
12					*				*		*		12	0.07
15		*			*				*				24	
18		*							*		*			
21	*	*							*		*			
Avg	*	*			*				*		*			
	N = 6				BLOWING DUST (visibility <11 km)									
00	1	*									*	*	1	1.00
03	1	*			*						*	*	3	0.63
06	*		*	*	*	*					*		6	0.44
09	*		*	*	1	1					*	*	9	0.13
12	*	*	*	*	3	1	*	*	1	*	*	1	12	0.09
15	1	*	*	*	3	1	*	*	1	*	*	*	24	0.03
18	1	1	*	*	1	1	*	*	1		1	*		
21	1	1	*		1	*	*	*	*		1	*		
Avg	*	*	*	*	1	1	*	*	*	*	*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 119

OCCURRENCE OF DUST - CHADAN, RSFSR, SOVIET CENTRAL ASIA (Jul 57 - Dec 68)

FIGURE 4 STATION 30

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.09				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	1.00
06													6	
09													9	
12													12	
15									*				24	
18														
21														
Avg									*					
	N = 3				BLOWING DUST (visibility <11 km)									
00													1	1.00
03													3	0.32
06													6	0.12
09													9	
12				1	*	1							12	
15			*	1	1	*			*				24	
18				1	*									
21														
Avg			*	*	*	*			*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 120

OCCURRENCE OF DUST - CHERDYN, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 31

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
01													1	
04													3	
07													6	
10							NONE REPORTED						9	
13													12	
16													24	
19														
22														
Avg														
	N = 0.05				BLOWING DUST (visibility <11 km)									
01													1	1.00
04					*								3	1.00
07													6	
10													9	
13													12	
16													24	
19														
22														
Avg					*									

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 121

OCCURRENCE OF DUST - IVDEL, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 32

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0					DUST STORMS (visibility <1 km)								
01													1	
04													3	
07													6	
10						NONE REPORTED							9	
13													12	
16													24	
19														
22														
Avg														
	N = 0.5					BLOWING DUST (visibility <11 km)								
01													1	1.00
04					*								3	0.45
07					*								6	0.26
10	*		*	*									9	
13	*												12	
16							*						24	
19							*							
22														
Avg	*		*	*	*		*							

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 122

OCCURRENCE OF DUST - KELLOG, RSFSR, SOVIET CENTRAL ASIA (Jul 57 - Dec 68)

FIGURE 4 STATION 33

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0					DUST STORMS (visibility <1 km)								
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.09					BLOWING DUST (visibility <11 km)								
00							*						1	1.00
03													3	1.00
06													6	
09													9	
12													12	
15													24	
18														
21														
Avg							*							

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 123

OCCURRENCE OF DUST - KHANTY-MANSIYSK, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 34

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0					DUST STORMS (visibility <1 km)								
02													1	
05													3	
08													6	
11							NONE REPORTED						9	
14													12	
17													24	
20														
23														
Avg														
	N = 0.2					BLOWING DUST (visibility <11 km)								
02													1	1.00
05													3	0.42
08													6	0.21
11	*									*			9	
14										*			12	
17													24	
20														
23														
Avg	*									*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 124

OCCURRENCE OF DUST - KHATANGA, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 35

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
01														
04														
07														
10						NONE REPORTED								
13														
16														
19														
22														
Avg														
	N = 0				BLOWING DUST (visibility <11 km)									
01														
04														
07														
10						NONE REPORTED								
13														
16														
19														
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 125

OCCURRENCE OF DUST - KHOSEDA KHARD, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 36

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
01													1	
04													3	
07													6	
10							NONE REPORTED						9	
13													12	
16													24	
19														
22														
Avg														
	N = 0.08				BLOWING DUST (visibility <11 km)									
01													1	1.00
04													3	0.63
07													6	0.63
10										*			9	
13										*			12	
16													24	
19														
22														
Avg										*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 126

OCCURRENCE OF DUST - KOCHUMDEK, RSFSR, SOVIET CENTRAL ASIA (Jul 57 - Dec 68)

FIGURE 4 STATION 37

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0			DUST STORMS (visibility <1 km)										
01														
04														
07														
10						NONE REPORTED								
13														
16														
19														
22														
Avg														
	N = 0			BLOWING DUST (visibility <11 km)										
01														
04														
07														
10						NONE REPORTED								
13														
16														
19														
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 127

OCCURRENCE OF DUST - KOLPASHEVO, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 38

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0					DUST STORMS (visibility <1 km)								
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.2					BLOWING DUST (visibility <11 km)								
00						*							1	1.00
03						*							3	0.67
06													6	0.67
09													9	
12													12	
15													24	
18			*											
21			*											
Avg			*			*								

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 128

OCCURRENCE OF DUST - KOSH AGACH, RSFSR, SOVIET CENTRAL ASIA (Jul 57 - Dec 68)

FIGURE 4 STATION 39

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 2				BLOWING DUST (visibility <11 km)									
00													1	1.00
03													3	0.30
06													6	0.09
09													9	
12						*				*			12	
15				*		1	1			*	*		24	
18										*				
21														
Avg				*		*	*			*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 129

OCCURRENCE OF DUST - KRASNOYARSK, RSFSR, SOVIET CENTRAL ASIA (Jun 46 - Dec 68)

FIGURE 4 STATION 40

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.2				DUST STORMS (visibility <1 km)									
00										*			1	1.00
03										*			3	0.64
06													6	0.64
09													9	
12													12	
15													24	
18				*	*									
21				*	*									
Avg				*	*					*				
	N = 1				BLOWING DUST (visibility <11 km)									
00				*	*					*			1	1.00
03				*	*			*		*			3	0.53
06				*									6	0.35
09				*	*								9	0.04
12				*	*								12	0.04
15				*	*								24	
18	*			*	1									
21	*			*	1									
Avg	*			*	*			*		*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 130

OCCURRENCE OF DUST - KURGAN, RSFSR, SOVIET CENTRAL ASIA (Feb 46 - Dec 68)

FIGURE 4 STATION 41

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.09				DUST STORMS (visibility <1 km)									
01													1	1.00
04													3	1.00
07													6	
10										*			9	
13													12	
16													24	
19														
22	*													
Avg	*									*				
	N = 0.9				BLOWING DUST (visibility <11 km)									
01					*						*		1	1.00
04													3	0.48
07													6	0.20
10					*					*			9	0.04
13					*								12	0.04
16	*				*	*							24	
19					*	*	*							
22	*				*						*			
Avg	*				*	*	*			*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 131

OCCURRENCE OF DUST - KUYUMBA, RSFSR, SOVIET CENTRAL ASIA (Jul 57 - Dec 68)

FIGURE 4 STATION 42

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00														
03														
06														
09						NONE REPORTED								
12														
15														
18														
21														
Avg														
	N = 0				BLOWING DUST (visibility <11 km)									
00														
03														
06														
09						NONE REPORTED								
12														
15														
18														
21														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 132

OCCURRENCE OF DUST - MAGNITOGORSK, RSFSR, SOVIET CENTRAL ASIA (Mar 46 - Dec 68)

FIGURE 4 STATION 43

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
N = 0.3	DUST STORMS (visibility <1 km)													
01													1	1.00
04									*				3	0.48
07									*				6	0.33
10													9	
13													12	
16					*								24	
19					*									
22							*							
Avg					*		*		*					
N = 2	BLOWING DUST (visibility <11 km)													
01					*	1	*						1	1.00
04									*			*	3	0.42
07									*				6	0.22
10				*									9	
13				*	*				*				12	
16					1								24	
19					*									
22					*	*	*							
Avg				*	*	*	*		*			*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 133

OCCURRENCE OF DUST - MAKSIMKIN YAR, RSFSR, SOVIET CENTRAL ASIA (Jul 57 - Dec 68)

FIGURE 4 STATION 44

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.09				BLOWING DUST (visibility <11 km)									
00													1	1.00
03													3	1.00
06													6	
09													9	
12						*							12	
15													24	
18														
21														
Avg						*								

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 134

OCCURRENCE OF DUST - MARRESALE, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 45

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.3				DUST STORMS (visibility <1 km)									
01	*												1	1.00
04													3	0.47
07													6	0.33
10													9	
13													12	
16								*					24	
19								*						
22	*					*								
Avg	*					*		*						
	N = 0.7				BLOWING DUST (visibility <11 km)									
01	*						*					*	1	1.00
04								*					3	0.58
07								*					6	0.50
10													9	
13													12	
16								*		*		*	24	
19								*		*		*		
22	*					*	*					*		
Avg	*					*	*	*		*		*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 135

OCCURRENCE OF DUST - MEN'SHIKOVA, MYS, RSFSR, SOVIET CENTRAL ASIA (Jan 59 - Dec 68)

FIGURE 4 STATION 46

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0.1				DUST STORMS (visibility <1 km)									
01													1	1.00
04													3	1.00
07													6	
10													9	
13													12	
16										*			24	
19														
22														
Avg										*				
	N = 0.1				BLOWING DUST (visibility <11 km)									
01													1	1.00
04													3	1.00
07													6	
10													9	
13													12	
16										*			24	
19														
22														
Avg										*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 136

OCCURRENCE OF DUST - NAR'YAN-MAR, RSFSR, SOVIET CENTRAL ASIA (Feb 53 - Dec 68)

FIGURE 4 STATION 47

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
01													1	
04													3	
07													6	
10						NONE REPORTED							9	
13													12	
16													24	
19														
22														
Avg														
	N = 0.2				BLOWING DUST (visibility <11 km)									
01										*			1	1.00
04													3	0.82
07													6	0.82
10													9	0.41
13							*						12	
16							*						24	
19							*							
22									*					
Avg							*		*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 137

OCCURRENCE OF DUST - NIZHNEUDINSK, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 48

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09													9	
12						NONE REPORTED							12	
15													24	
18														
21														
Avg														
	N = 0.8				BLOWING DUST (visibility <11 km)									
00					*			*					1	1.00
03					*			*					3	0.53
06					*				*				6	0.41
09			*						*				9	
12			*										12	
15													24	
18	*									*		*		
21	*									*				
Avg	*		*		*			*	*	*		*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 138

OCCURRENCE OF DUST - OKTYABR'SKOYE, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 49

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	Diurnal Variation by Month (%)												Duration Factor	
	N = 0.05			DUST STORMS (visibility <1 km)										
01									*				1	1.00
04													3	1.00
07													6	
10													9	
13													12	
16													24	
19														
22														
Avg									*					
	N = 0.05			BLOWING DUST (visibility <11 km)										
01									*				1	1.00
04													3	1.00
07													6	
10													9	
13													12	
16													24	
19														
22														
Avg									*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 139

OCCURRENCE OF DUST - OMSK, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 50

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	N = 0.8				DUST STORMS (visibility <1 km)									
02													1	1.00
05													3	0.25
08													6	0.06
11													9	
14					*								12	
17					*								24	
20					*	*								
23				*										
Avg				*	*	*								
	N = 4				BLOWING DUST (visibility <11 km)									
02					*				*				1	1.00
05			*	*	*	*					*		3	0.56
08			*	*	*	*					*		6	0.33
11					1	1		*	*	*	*		9	0.08
14				1	2	*			*	*	*		12	0.05
17				1	2	1					*		24	
20				1	2	*			*		*			
23				*	*				*		*			
Avg			*	*	1	*		*	*	*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 140

OCCURRENCE OF DUST - ONGUDAY, RSFSR, SOVIET CENTRAL ASIA (Jul 57 - Dec 68)

FIGURE 4 STATION 51

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0			DUST STORMS (visibility <1 km)										
01														
04														
07														
10						NONE REPORTED								
13														
16														
19														
22														
Avg														
	N = 0			BLOWING DUST (visibility <11 km)										
01														
04														
07														
10						NONE REPORTED								
13														
16														
19														
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 141

OCCURRENCE OF DUST - ORENBURG, RSFSR, SOVIET CENTRAL ASIA (Jan 46 - Dec 68)

FIGURE 4 STATION 52

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
01													1	
04													3	
07													6	
10													9	
13						NONE REPORTED							12	
16													24	
19														
22														
Avg														

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 1				BLOWING DUST (visibility <11 km)									
01				*			*				*	*	1	1.00
04								*			*		3	0.63
07								*	*		*		6	0.49
10	*			*	*	*	*		*				9	0.12
13	*			*	*	*	*	*	*				12	0.09
16				*		1		*			*	*	24	
19				*		1					*	*		
22	*			*			*				*	*		
Avg	*			*	*	*	*	*	*		*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 142

OCCURRENCE OF DUST - ORLIK, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 53

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.08				DUST STORMS (visibility <1 km)									
01													1	1.00
04							*						3	0.63
07							*						6	0.63
10													9	
13													12	
16													24	
19														
22														
Avg							*							
	N = 0.08				BLOWING DUST (visibility <11 km)									
01													1	1.00
04													3	0.63
07							*						6	0.63
10							*						9	
13													12	
16													24	
19														
22														
Avg							*							

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 143

OCCURRENCE OF DUST - OSTROV KUPFFER, RSFSR, SOVIET CENTRAL ASIA (Jan 59 - Dec 68)

FIGURE 4 STATION 54

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
01														
04														
07														
10														
13						NONE REPORTED								
16														
19														
22														
Avg														
	N = 0				BLOWING DUST (visibility <11 km)									
01														
04														
07														
10														
13						NONE REPORTED								
16														
19														
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 144

OCCURRENCE OF DUST - PERM, RSFSR, SOVIET CENTRAL ASIA (Mar 46 - Dec 68)

FIGURE 4 STATION 55

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0.05				DUST STORMS (visibility <1 km)									
01													1	1.00
04													3	1.00
07													6	
10													9	
13					*								12	
16													24	
19														
22														
Avg					*									
	N = 0.8				BLOWING DUST (visibility <11 km)									
01								*	*	*			1	1.00
04	*	*											3	0.52
07	*	*											6	0.39
10													9	
13					*			*					12	
16								*					24	
19								*						
22								*	*	*				
Avg	*	*			*			*	*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 145

OCCURRENCE OF DUST - PODKAMENNAYA TUNGUSKA, RSFSR, SOVIET CENTRAL ASIA (Feb 53 - Dec 68)

FIGURE 4 STATION 56

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0					DUST STORMS (visibility <1 km)								
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.2					BLOWING DUST (visibility <11 km)								
00													1	1.00
03													3	0.65
06													6	0.65
09													9	
12					*	*							12	
15					*	*							24	
18														
21														
Avg					*	*								

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 146

OCCURRENCE OF DUST - PUDINO, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 57

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0					DUST STORMS (visibility <1 km)								
02													1	
05													3	
08													6	
11							NONE REPORTED						9	
14													12	
17													24	
20														
23														
Avg														
	N = 0.2					BLOWING DUST (visibility <11 km)								
02							*						1	1.00
05													3	0.42
08													6	0.21
11													9	
14										*			12	
17										*			24	
20														
23														
Avg							*			*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 147

OCCURRENCE OF DUST - SALEKHARD, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 58

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
01													1	
04													3	
07													6	
10						NONE REPORTED							9	
13													12	
16													24	
19														
22														
Avg														
	N = 0.3				BLOWING DUST (visibility <11 km)									
01													1	1.00
04	*											*	3	0.47
07	*											*	6	0.33
10													9	
13													12	
16													24	
19														
22												*		
Avg	*											*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 148

OCCURRENCE OF DUST - SARYG-SEP, RSFSR, SOVIET CENTRAL ASIA (Jul 57 - Dec 68)

FIGURE 4 STATION 59

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.09				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	1.00
06													6	
09													9	
12					*								12	
15													24	
18														
21														
Avg					*									
	N = 1				BLOWING DUST (visibility <11 km)									
00													1	1.00
03													3	0.34
06													6	0.14
09													9	
12					*								12	
15									*				24	
18					*	*			*	*				
21						*								
Avg					*	*			*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 149

OCCURRENCE OF DUST - SEROV, RSFSR, SOVIET CENTRAL ASIA (Mar 46 - Dec 68)

FIGURE 4 STATION 60

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0			DUST STORMS (visibility <1 km)										
01													1	
04													3	
07													6	
10						NONE REPORTED							9	
13													12	
16													24	
19														
22														
Avg														
	N = 0.5			BLOWING DUST (visibility <11 km)										
01		*									*		1	1.00
04									*			*	3	0.47
07									*			*	6	0.33
10													9	
13	*							*					12	
16													24	
19														
22		*									*			
Avg	*	*						*	*		*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 150

OCCURRENCE OF DUST - STERLEGOVA, MYS, RSFSR, SOVIET CENTRAL ASIA (Mar 55 - Dec 68)

FIGURE 4 STATION 61

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
N = 0.1				DUST STORMS (visibility <1 km)										
00						*							1	1.00
03							*						3	0.58
06													6	0.58
09													9	
12													12	
15													24	
18														
21														
Avg						*	*							
N = 0.2				BLOWING DUST (visibility <11 km)										
00						*							1	1.00
03							*						3	0.65
06							*						6	0.65
09							*						9	
12													12	
15													24	
18														
21														
Avg						*	*							

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 151

OCCURRENCE OF DUST - SVERDLOVSK, RSFSR, SOVIET CENTRAL ASIA (Jan 46 - Dec 68)

FIGURE 4 STATION 62

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.07				DUST STORMS (visibility <1 km)									
01													1	1.00
04													3	0.57
07													6	0.57
10													9	
13													12	
16												*	24	
19												*		
22														
Avg												*		
	N = 0.3				BLOWING DUST (visibility <11 km)									
01					*						*		1	1.00
04													3	0.61
07					*								6	0.61
10					*								9	
13													12	
16												*	24	
19												*		
22					*					*				
Avg					*					*	*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 152

OCCURRENCE OF DUST - SYKTYVKAR, RSFSR, SOVIET CENTRAL ASIA (Feb 53 - Dec 68)

FIGURE 4 STATION 63

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	Diurnal Variation by Month (%)													
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.2				BLOWING DUST (visibility <11 km)									
00	*											*	1	1.00
03													3	0.65
06													6	0.65
09									*			*	9	
12									*			*	12	
15													24	
18														
21	*											*		
Avg	*								*			*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 153

OCCURRENCE OF DUST - TARA, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 64

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02													1	
05													3	
08													6	
11						NONE REPORTED							9	
14													12	
17													24	
20														
23														
Avg														
	N = 0.9				BLOWING DUST (visibility <11 km)									
02									*				1	1.00
05						*		*					3	0.55
08						*		*					6	0.43
11					*								9	
14					*				*				12	
17	*	*			*		*		*				24	
20		*			*		*		*					
23									*					
Avg	*	*			*	*	*	*	*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 154

OCCURRENCE OF DUST - TARKO SALE, RSFSR, SOVIET CENTRAL ASIA (Jul 57 - Dec 68)

FIGURE 4 STATION 65

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02													1	
05													3	
08													6	
11						NONE REPORTED							9	
14													12	
17													24	
20														
23														
Avg														
	N = 0.4				BLOWING DUST (visibility <11 km)									
02										*			1	1.00
05													3	0.70
08													6	0.46
11													9	0.24
14									*				12	
17								*	*				24	
20										*				
23										*				
Avg								*	*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 155

OCCURRENCE OF DUST - TISUL, RSFSR, SOVIET CENTRAL ASIA (Feb 53 - Dec 68)

FIGURE 4 STATION 66

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.7				BLOWING DUST (visibility <11 km)									
00													1	1.00
03													3	0.44
06													6	0.27
09													9	
12		*		*	*		*						12	
15		*		*	*		*						24	
18														
21														
Avg		*		*	*		*							

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 156

OCCURRENCE OF DUST - TOBOL'SK, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 67

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	Diurnal Variation by Month (%)													
	N = 0.08				DUST STORMS (visibility <1 km)									
02													1	1.00
05								*					3	0.63
08								*					6	0.63
11													9	
14													12	
17													24	
20														
23														
Avg								*						
	N = 0.4				BLOWING DUST (visibility <11 km)									
02								*		*			1	1.00
05		*						*					3	0.55
08		*						*					6	0.43
11													9	
14													12	
17					*								24	
20														
23								*		*				
Avg		*			*			*		*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 157

OCCURRENCE OF DUST - TROITSKO-PECHORSK, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 68

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
01														
04														
07														
10														
13							NONE REPORTED							
16														
19														
22														
Avg														
	N = 0				BLOWING DUST (visibility <11 km)									
01														
04														
07														
10														
13							NONE REPORTED							
16														
19														
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 158

OCCURRENCE OF DUST - TSIL'MA-UST, RSFSR, SOVIET CENTRAL ASIA (Feb 53 - Dec 68)

FIGURE 4 STATION 69

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
													Duration Factor	
	Diurnal Variation by Month (%)													
	N = 0					DUST STORMS (visibility <1 km)								
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.6					BLOWING DUST (visibility <11 km)								
00													1	1.00
03													3	0.53
06													6	0.43
09													9	
12													12	
15	*	*										*	24	
18	*	*										*		
21										*				
Avg	*	*								*		*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 159

OCCURRENCE OF DUST - TUROCHAK, RSFSR, SOVIET CENTRAL ASIA (Jan 48 - Dec 68)

FIGURE 4 STATION 70

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0.05				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	1.00
06													6	
09													9	
12													12	
15													24	
18			*											
21														
Avg			*											
	N = 0.3				BLOWING DUST (visibility <11 km)									
00													1	1.00
03													3	0.63
06									*				6	0.33
09													9	0.17
12					*								12	
15			*		*								24	
18			*		*					*				
21														
Avg			*		*				*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 160

OCCURRENCE OF DUST - TURUKHANSK, RSFSR, SOVIET CENTRAL ASIA (Feb 53 - Dec 68)

FIGURE 4 STATION 71

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00														
03														
06														
09						NONE REPORTED								
12														
15														
18														
21														
Avg														
	N = 0				BLOWING DUST (visibility <11 km)									
00														
03														
06														
09						NONE REPORTED								
12														
15														
18														
21														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 161

OCCURRENCE OF DUST - UFA, RSFSR, SOVIET CENTRAL ASIA (Mar 46 - Dec 68)

FIGURE 4 STATION 72

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	Diurnal Variation by Month (%)												Duration Factor	
	N = 0.2				DUST STORMS (visibility <1 km)									
01													1	1.00
04													3	0.41
07													6	0.18
10													9	
13													12	
16							*						24	
19							*							
22							*							
Avg							*							
	N = 1				BLOWING DUST (visibility <11 km)									
01							*	*					1	1.00
04					*		*	1					3	0.48
07					*		*	*					6	0.27
10												*	9	0.03
13				*								*	12	
16				*		*	*						24	
19				*		*	*							
22	*						*	*						
Avg	*			*	*	*	*	*				*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 162

OCCURRENCE OF DUST - VOLOCHANKA, RSFSR, SOVIET CENTRAL ASIA (Mar 55 - Dec 68)

FIGURE 4 STATION 73

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
N = 0					DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09							NONE REPORTED						9	
12													12	
15													24	
18														
21														
Avg														
N = 0.2					BLOWING DUST (visibility <11 km)									
00											*		1	1.00
03											*		3	0.65
06													6	0.65
09													9	
12													12	
15													24	
18								*						
21								*						
Avg								*			*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 163

OCCURRENCE OF DUST - VORKUTA, RSFSR, SOVIET CENTRAL ASIA (Feb 53 - Dec 63)

FIGURE 4 STATION 74

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	Diurnal Variation by Month (%)												Duration Factor	
	N = 0				DUST STORMS (visibility <1 km)									
01														
04														
07														
10														
13						NONE REPORTED								
16														
19														
22														
Avg														
	N = 0				BLOWING DUST (visibility <11 km)									
01														
04														
07														
10														
13						NONE REPORTED								
16														
19														
22														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 164

OCCURRENCE OF DUST - YELABUGA, RSFSR, SOVIET CENTRAL ASIA (Aug 47 - Dec 68)

FIGURE 4 STATION 75

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	Diurnal Variation by Month (%)												Duration Factor	
	N = 0.05				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	1.00
06													6	
09													9	
12													12	
15													24	
18						*								
21														
Avg						*								
	N = 1				BLOWING DUST (visibility <11 km)									
00													1	1.00
03													3	0.19
06													6	0.03
09													9	
12				*							*		12	
15				*	*			*					24	
18						*								
21														
Avg				*	*	*		*			*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 165

OCCURRENCE OF DUST - ZAKATALY, AZERBAIJAN, USSR (Jan 48 - Dec 68)

FIGURE 5 STATION 1

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.5				DUST STORMS (visibility <1 km)									
00													1	1.00
03									*				3	0.30
06													6	0.11
09													9	
12													12	
15												*	24	
18	*											*		
21														
Avg	*								*			*		
	N = 1				BLOWING DUST (visibility <11 km)									
00						*					*		1	1.00
03					*			*	*	*			3	0.45
06					*			*		*			6	0.27
09													9	
12													12	
15									*			*	24	
18	*								*			*		
21			*								*			
Avg	*		*		*	*		*	*	*	*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 166

OCCURRENCE OF DUST - BREST, BYELORUSSIA, USSR (Jan 55 - Dec 68)

FIGURE 5 STATION 2

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02													1	
05													3	
08						NONE REPORTED							6	
11													9	
14													12	
17													24	
20														
23														
Avg														
	N = 3				BLOWING DUST (visibility <11 km)									
02						*							1	1.00
05													3	0.49
08													6	0.19
11				1		*							9	0.05
14				1	*		*						12	
17				1					*	*			24	
20									*	*				
23				*		1			*					
Avg				*	*	*	*		*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 167

OCCURRENCE OF DUST - MINSK, BYELORUSSIA, USSR (Aug 47 - Dec 68)

FIGURE 5 STATION 3

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.1				DUST STORMS (visibility <1 km)									
02													1	1.00
05													3	0.67
08											*		6	0.67
11											*		9	
14													12	
17													24	
20														
23														
Avg											*			
	N = 0.4				BLOWING DUST (visibility <11 km)									
02													1	1.00
05													3	0.52
08											*		6	0.39
11				*							*		9	
14				*									12	
17													24	
20		*												
23		*												
Avg		*		*							*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 168

OCCURRENCE OF DUST - TALLINN, ESTONIA, USSR (Feb 53 - Dec 68)

FIGURE 5 STATION 4

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02													1	
05													3	
08						NONE REPORTED							6	
11													9	
14													12	
17													24	
20														
23														
Avg														
	N = 0.1				BLOWING DUST (visibility <11 km)									
02													1	1.00
05													3	0.63
08													6	0.63
11													9	
14													12	
17													24	
20	*													
23	*													
Avg	*													

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

AD-A040 581 ARMY ELECTRONICS COMMAND WHITE SANDS MISSILE RANGE N--ETC F/G 4/1
BOUNDARY LAYER DUST OCCURRENCE, III, ATMOSPHERIC DUST OVER RUSS--ETC(U)
MAY 77 B D HINDS, G B HOIDALE

UNCLASSIFIED ECOM-DR-77-2 NL

3 OF 5
ADA040581

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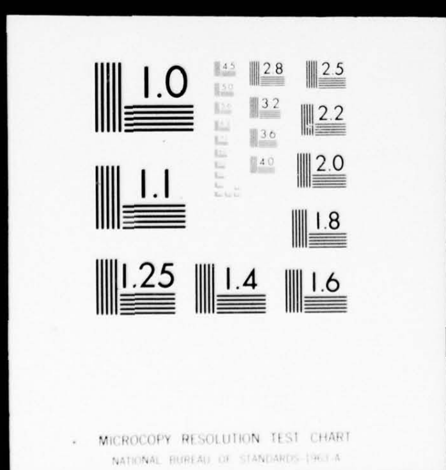

TABLE 169

OCCURRENCE OF DUST - BATUMI, GEORGIA, USSR (Jan 59 - Dec 68)

FIGURE 5 STATION 5

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0			DUST STORMS (visibility <1 km)										
02														
05														
08														
11						NONE REPORTED								
14														
17														
20														
23														
Avg														
	N = 0			BLOWING DUST (visibility <11 km)										
02														
05														
08														
11						NONE REPORTED								
14														
17														
20														
23														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 170

OCCURRENCE OF DUST - TBILISI, GEORGIA, USSR (Jan 59 - Dec 68)

FIGURE 5 STATION 6

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 2				BLOWING DUST (visibility <11 km)									
00													1	1.00
03				*									3	0.33
06				*									6	0.12
09									*				9	
12									1				12	
15			*	1	*								24	
18				*										
21			*											
Avg			*	*	*				*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 171

OCCURRENCE OF DUST - ALEKSANDROV-GAY, KAZAKH, USSR (Jan 48 - Dec 68)

FIGURE 5 STATION 7

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
						Diurnal Variation by Month (%)								
N = 0.3						DUST STORMS (visibility <1 km)								
00										*			1	1.00
03													3	0.66
06													6	0.48
09		*											9	0.17
12		*											12	0.17
15					*					*			24	
18					*					*				
21										*				
Avg		*			*					*				
N = 18						BLOWING DUST (visibility <11 km)								
00					1	*	*	*	*	*			1	1.00
03					*		*						3	0.58
06							*						6	0.31
09		*		1	1	1	2	2	3	1			9	0.11
12	*	*		1	3	2	4	4	4	1			12	0.05
15	*			1	3	3	6	6	5	1			24	
18				1	2	2	4	4	3	1				
21					1	*	1	1	*	*				
Avg	*	*		1	1	1	2	2	2	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 172

OCCURRENCE OF DUST - RIGA, LATVIA, USSR (Aug 47 - Dec 68)

FIGURE 5 STATION 8

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02													1	
05													3	
08													6	
11						NONE REPORTED							9	
14													12	
17													24	
20														
23														
Avg														
	N = 0.3				BLOWING DUST (visibility <11 km)									
02													1	1.00
05										*			3	0.63
08										*		*	6	0.63
11				*								*	9	
14				*							*		12	
17											*		24	
20														
23														
Avg				*						*	*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 173

OCCURRENCE OF DUST - KALININGRAD, LITHUANIA, USSR (Jan 55 - Dec 68)

FIGURE 5 STATION 9

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
01													1	
04													3	
07													6	
10						NONE REPORTED							9	
13													12	
16													24	
19														
22														
Avg														
	N = 0.1				BLOWING DUST (visibility <11 km)									
01													1	1.00
04													3	0.64
07													6	0.64
10													9	
13													12	
16				*									24	
19				*										
22														
Avg				*										

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 174

OCCURRENCE OF DUST - KAUNAS, LITHUANIA, USSR (Feb 53 - Dec 68)

FIGURE 5 STATION 10

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02														
05														
08							NONE REPORTED							
11														
14														
17														
20														
23														
Avg														
	N = 0				BLOWING DUST (visibility <11 km)									
02														
05														
08														
11							NONE REPORTED							
14														
17														
20														
23														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 175

OCCURRENCE OF DUST - ARCHANGEL, RSFSR, USSR (Aug 47 - Dec 68)

FIGURE 5 STATION 11

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.1				BLOWING DUST (visibility <11 km)									
00				*									1	1.00
03													3	0.60
06													6	0.60
09													9	
12													12	
15		*											24	
18		*												
21				*										
Avg		*		*										

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 176

OCCURRENCE OF DUST - ASTRAKHAN, RSFSR, USSR (Feb 53 - Dec 68)

FIGURE 5 STATION 12

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.1					DUST STORMS (visibility <1 km)								
00													1	1.00
03													3	1.00
06													6	
09													9	
12													12	
15				*									24	
18														
21														
Avg				*										
	N = 2					BLOWING DUST (visibility <11 km)								
00													1	1.00
03													3	0.48
06													6	0.20
09				*				*	*				9	0.05
12				1	*			*		1			12	
15			*	2	*				*	*			24	
18			*	1	*				*					
21				*										
Avg			*	*	*			*	*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 177

OCCURRENCE OF DUST - BRYANSK, RSFSR, USSR (Jan 48 - Dec 68)

FIGURE 5 STATION 13

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02														
05														
08														
11						NONE REPORTED								
14														
17														
20														
23														
Avg														
	N = 0				BLOWING DUST (visibility <11 km)									
02														
05														
08														
11						NONE REPORTED								
14														
17														
20														
23														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 178

OCCURRENCE OF DUST - CHEREPOVETS, RSFSR, USSR (Mar 55 - Dec 68)

FIGURE 5 STATION 14

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	N = 0			DUST STORMS (visibility <1 km)										
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.1			BLOWING DUST (visibility <11 km)										
00													1	1.00
03													3	0.67
06													6	0.67
09													9	
12													12	
15												*	24	
18												*		
21														
Avg												*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 179

OCCURRENCE OF DUST - EL'TON, RSFSR, USSR (Jan 60 - Dec 68)

FIGURE 5 STATION 15

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.1				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	1.00
06													6	1.00
09													9	1.00
12													12	
15									1				24	
18									1					
21									1					
Avg									*					
	N = 12				BLOWING DUST (visibility <11 km)									
00					*				*	*			1	1.00
03					*								3	0.57
06								1					6	0.29
09					*	1	1	1	1				9	0.11
12					5	1	2	4	4	1	*		12	0.03
15				1	4	1	1	3	5	1			24	
18					2	1	2	4	3	1				
21							2	1	2	*				
Avg				*	1	*	1	2	2	*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 180

OCCURRENCE OF DUST - GRIDINO, RSFSR, USSR (Jul 46 - Dec 68)

FIGURE 5 STATION 16

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02														
05														
08														
11						NONE REPORTED								
14														
17														
20														
23														
Avg														
	N = 0				BLOWING DUST (visibility <11 km)									
02														
05														
08						NONE REPORTED								
11														
14														
17														
20														
23														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 181

OCCURRENCE OF DUST - GRYAZNAYA, RSFSR, USSR (Sep 53 - Dec 63)

FIGURE 5 STATION 17

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02														
05														
08														
11						NONE REPORTED								
14														
17														
20														
23														
Avg														
	N = 0				BLOWING DUST (visibility <11 km)									
02														
05														
08														
11						NONE REPORTED								
14														
17														
20														
23														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 182

OCCURRENCE OF DUST - KANDALAKSHA, RSFSR, USSR (Jan 48 - Dec 68)

FIGURE 5 STATION 18

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	Diurnal Variation by Month (%)												Duration Factor	
	N = 0				DUST STORMS (visibility <1 km)									
02													1	
05													3	
08						NONE REPORTED							6	
11													9	
14													12	
17													24	
20														
23														
Avg														
	N = 0.08				BLOWING DUST (visibility <11 km)									
02									*				1	1.00
05									*				3	0.63
08													6	0.63
11													9	
14													12	
17													24	
20														
23														
Avg									*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 183

OCCURRENCE OF DUST - KANIN NOS, RSFSR, USSR (Oct 47 - Dec 68)

FIGURE 5 STATION 19

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0					DUST STORMS (visibility <1 km)								
00														
03														
06														
09						NONE REPORTED								
12														
15														
18														
21														
Avg														
	N = 0					BLOWING DUST (visibility <11 km)								
00														
03														
06														
09						NONE REPORTED								
12														
15														
18														
21														
Avg														

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 184

OCCURRENCE OF DUST - KAPUSTIN YAR, RSFSR, USSR (Jan 59 - Dec 68)

FIGURE 5 STATION 20

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
N = 0.5						DUST STORMS (visibility <1 km)								
00													1	1.00
03													3	0.39
06													6	0.20
09													9	
12							*						12	
15									*				24	
18									*					
21														
Avg							*		*					
N = 6						BLOWING DUST (visibility <11 km)								
00													1	1.00
03													3	0.58
06													6	0.41
09					*		*	*					9	0.08
12				*	3	1	2	1	1	*			12	
15				2	2	2	2	2	1	*			24	
18				2	1	*	*	*	*	*				
21				*		*		1						
Avg				1	1	*	1	1	*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 185

OCCURRENCE OF DUST - KAZAN, RSFSR, USSR (Jan 48 - Dec 68)

FIGURE 5 STATION 21

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	N = 0.08				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	0.63
06													6	0.63
09			*										9	
12			*										12	
15													24	
18														
21														
Avg			*											
	N = 2				BLOWING DUST (visibility <11 km)									
00							*				*		1	1.00
03										*	*		3	0.52
06					*					*	*		6	0.29
09			*	*					*	*	*		9	0.03
12			*	*				*	*	*	*		12	0.03
15						*	*	*	*	*	*		24	
18					*				*	*	*			
21					*		*			*	*			
Avg			*	*	*	*	*	*	*	*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 186

OCCURRENCE OF DUST - KIROV, RSFSR, USSR (Mar 55 - Dec 68)

FIGURE 5 STATION 22

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0.1				DUST STORMS (visibility <1 km)									
00													1	1.00
03					*								3	0.58
06					*								6	0.58
09													9	
12													12	
15													24	
18														
21														
Avg					*									
	N = 0.1				BLOWING DUST (visibility <11 km)									
00													1	1.00
03					*								3	0.58
06					*								6	0.58
09													9	
12													12	
15													24	
18														
21														
Avg					*									

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 187

OCCURRENCE OF DUST - KRASNODAR, RSFSR, USSR (Jan 48 - Dec 68)

FIGURE 5 STATION 23

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 1				DUST STORMS (visibility <1 km)									
00													1	1.00
03											*		3	0.33
06											*		6	0.12
09													9	
12													12	
15		*	*	1									24	
18			*	*										
21														
Avg		*	*	*							*			
	N = 3				BLOWING DUST (visibility <11 km)									
00	*	*	1	1			*	1		*	*		1	1.00
03			*	*							*		3	0.73
06				*							*		6	0.57
09			*	*					*				9	0.26
12			1	1									12	0.21
15		1	1	2	*			*					24	
18		1	1	1	*									
21	*	1	1	1			*	1	*	*	*			
Avg	*	*	1	1	*		*	*	*	*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 188

OCCURRENCE OF DUST - KURSK, RSFSR, USSR (Aug 47 - Dec 68)

FIGURE 5 STATION 24

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.07				DUST STORMS (visibility <1 km)									
02													1	1.00
05													3	0.71
08										*			6	0.71
11										*			9	
14													12	
17													24	
20														
23														
Avg										*				
	N = 0.8				BLOWING DUST (visibility <11 km)									
02													1	1.00
05													3	0.46
08									*	*			6	0.28
11							*		*	*			9	
14						*		*		*	*		12	
17										*	*		24	
20									*					
23									*					
Avg						*	*	*	*	*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 189

OCCURRENCE OF DUST - KUYBYSHEV, RSFSR, USSR (Aug 47 - Dec 68)

FIGURE 5 STATION 25

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0					DUST STORMS (visibility <1 km)								
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.5					BLOWING DUST (visibility <11 km)								
00													1	1.00
03											*		3	0.63
06											*		6	0.63
09					*				*				9	
12					*				*				12	
15				*	*			*				*	24	
18				*	*			*				*		
21														
Avg				*	*			*	*		*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 190

OCCURRENCE OF DUST - LENINGRAD, RSFSR, USSR (Aug 47 - Dec 68)

FIGURE 5 STATION 26

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02													1	
05													3	
08													6	
11						NONE REPORTED							9	
14													12	
17													24	
20														
23														
Avg														
	N = 0.4				BLOWING DUST (visibility <11 km)									
02											*	*	1	1.00
05											*	*	3	0.53
08													6	0.44
11													9	
14						*				*			12	
17						*				*			24	
20														
23														
Avg						*				*	*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 191

OCCURRENCE OF DUST - LUKJYIANOV, RSFSR, USSR (Aug 47 - Dec 68)

FIGURE 5 STATION 27

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 1				BLOWING DUST (visibility <11 km)									
00		*											1	1.00
03						*							3	0.28
06						*							6	0.08
09													9	
12													12	
15					1	*		*					24	
18														
21		*												
Avg		*			*	*		*						

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 192

OCCURRENCE OF DUST - MAKHACHKALA, RSFSR, USSR (Jan 48 - Dec 68)

FIGURE 5 STATION 28

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.4				DUST STORMS (visibility <1 km)									
00						*							1	1.00
03												*	3	0.51
06												*	6	0.38
09													9	
12													12	
15			*										24	
18			*											
21					*	*								
Avg			*		*	*						*		
	N = 2				BLOWING DUST (visibility <11 km)									
00			*			*							1	1.00
03		*	*									*	3	0.57
06		*	*									*	6	0.40
09		*	*	*	*		*			*		*	9	0.08
12		*	*		*		*			*		*	12	0.08
15		*	*	*	*		*	*	*	*		*	24	
18		*	*		*		*		*	*		1		
21			*		*	*		*						
Avg		*	*	*	*	*	*	*	*	*		*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 193

OCCURRENCE OF DUST - MEZEN, RSFSR, USSR (Aug 47 - Dec 68)

FIGURE 5 STATION 29

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.05				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	1.00
06							*						6	
09													9	
12													12	
15													24	
18														
21														
Avg							*							
	N = 0.3				BLOWING DUST (visibility <11 km)									
00													1	1.00
03			*										3	0.50
06			*				*						6	0.31
09													9	
12													12	
15										*			24	
18										*				
21														
Avg			*				*			*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 194

OCCURRENCE OF DUST - MOSCOW, RSFSR, USSR (Aug 47 - Dec 68)

FIGURE 5 STATION 30

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.7				BLOWING DUST (visibility <11 km)									
00							*	*		*			1	1.00
03							*	*					3	0.51
06													6	0.39
09													9	
12				*									12	
15	*					*			*				24	
18	*					*				*				
21														
Avg	*			*		*	*	*	*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 195

OCCURRENCE OF DUST - NIKOL'SK, RSFSR, USSR (Jan 48 - Dec 68)

FIGURE 5 STATION 31

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.2				BLOWING DUST (visibility <11 km)									
00						*							1	1.00
03													3	0.42
06													6	0.21
09				*									9	
12				*									12	
15													24	
18														
21														
Avg				*		*								

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 196

OCCURRENCE OF DUST - PENZA, RSFSR, USSR (Aug 47 - Dec 68)

FIGURE 5 STATION 32

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0					DUST STORMS (visibility <1 km)								
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.4					BLOWING DUST (visibility <11 km)								
00					*								1	1.00
03												*	3	0.53
06												*	6	0.39
09	*												9	
12													12	
15			*										24	
18			*											
21					*									
Avg	*		*		*							*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 197

OCCURRENCE OF DUST - PRIKUMSK, RSFSR, USSR (Jan 48 - Dec 68)

FIGURE 5 STATION 33

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.4				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	0.65
06													6	0.51
09									*				9	0.14
12	*								*				12	0.14
15	*				*				*				24	
18	*				*	*			*					
21	*													
Avg	*				*	*			*					
	N = 9				BLOWING DUST (visibility <11 km)									
00	*			*	1	*							1	1.00
03				*	*								3	0.56
06				*				*					6	0.37
09		*	*		*	*	*	1	*	*	*		9	0.06
12	1	*	*	*	1	*	*	1	*	1	*		12	0.04
15	1		*	3	3	1	1	2	2	*		*	24	
18	*		1	3	4	1	1	2	*					
21	*			1	2	*	*							
Avg	*	*	*	1	2	*	*	1	*	*	*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 198

OCCURRENCE OF DUST - PYALITSA, RSFSR, USSR (Aug 47 - Dec 68)

FIGURE 5 STATION 34

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0.05				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	
06									*				6	
09													9	
12													12	
15													24	
18														
21														
Avg									*					
	N = 0.7				BLOWING DUST (visibility <11 km)									
00													1	1.00
03													3	0.25
06									*				6	0.07
09		*		*									9	
12		*											12	
15			*										24	
18														
21														
Avg		*	*	*					*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 199

OCCURRENCE OF DUST - ROSTOV-ON-THE-DON, RSFSR, USSR (Jan 48 - Dec 68)

FIGURE 5 STATION 35

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.5					DUST STORMS (visibility <1 km)								
00													1	1.00
03													3	0.30
06													6	0.11
09													9	
12				*									12	
15				*									24	
18				*										
21														
Avg				*										
	N = 2					BLOWING DUST (visibility <11 km)								
00			*										1	1.00
03			*										3	0.60
06			*										6	0.41
09											*		9	0.10
12			*	1				*			*		12	0.04
15			1	2	*	*	*	*					24	
18			*	1	*	*	*	*						
21			*	*				*						
Avg			*	*	*	*	*	*			*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 200

OCCURRENCE OF DUST - RYAZAN, RSFSR, USSR (Aug 47 - Dec 68)

FIGURE 5 STATION 36

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.2				BLOWING DUST (visibility <11 km)									
00	*												1	1.00
03													3	0.50
06													6	0.50
09					*				*				9	
12					*				*				12	
15													24	
18														
21	*													
Avg	*				*				*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 201

OCCURRENCE OF DUST - SARATOV, RSFSR, USSR (Jan 48 - Dec 68)

FIGURE 5 STATION 37

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.2				DUST STORMS (visibility <1 km)									
00													1	1.00
03			*										3	0.42
06			*										6	0.21
09													9	
12				*									12	
15													24	
18														
21														
Avg			*	*										
	N = 2				BLOWING DUST (visibility <11 km)									
00													1	1.00
03			*										3	0.39
06			*										6	0.11
09									*	*			9	0.02
12				*	*					*			12	
15				*	*		*	1		*			24	
18				1										
21					*		*							
Avg			*	*	*		*	*	*	*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 202

OCCURRENCE OF DUST - SMOLENSK, RSFSR, USSR (Jan 48 - Dec 68)

FIGURE 5 STATION 38

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	Diurnal Variation by Month (%)												Duration Factor	
	N = 0.2				DUST STORMS (visibility <1 km)									
02			*										1	1.00
05			*										3	0.42
08													6	0.21
11													9	
14	*												12	
17													24	
20														
23														
Avg	*		*											
	N = 0.3				BLOWING DUST (visibility <11 km)									
02			*										1	1.00
05			*										3	0.47
08													6	0.33
11													9	
14	*												12	
17													24	
20			*											
23			*											
Avg	*		*											

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 203

OCCURRENCE OF DUST - SURA, RSFSR, USSR (Jan 48 - Dec 68)

FIGURE 5 STATION 39

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.08				BLOWING DUST (visibility <11 km)									
00													1	1.00
03													3	0.62
06													6	0.62
09													9	
12								*					12	
15								*					24	
18														
21														
Avg								*						

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 204

OCCURRENCE OF DUST - TUAPSE, RSFSR, USSR (Jan 55 - Dec 68)

FIGURE 5 STATION 40

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	Diurnal Variation by Month (%)												Duration Factor	
	N = 0.07				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	1.00
06													6	
09													9	
12											*		12	
15													24	
18														
21														
Avg											*			
	N = 0.1				BLOWING DUST (visibility <11 km)									
00													1	1.00
03													3	1.00
06													6	
09													9	
12											*		12	
15													24	
18														
21						*								
Avg						*					*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 205

OCCURRENCE OF DUST - VERKHNIY BASKUNCHAK, RSFSR, USSR (Aug 47 - Dec 68)

FIGURE 5 STATION 41

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0.6				DUST STORMS (visibility <1 km)									
00	*					*							1	1.00
03								*					3	0.53
06													6	0.23
09													9	0.08
12													12	
15	*					*	*	*		*			24	
18										*				
21	*					*								
Avg	*					*	*	*		*				
	N = 5				BLOWING DUST (visibility <11 km)									
00	*			*		*		*		*		*	1	1.00
03	*							*				*	3	0.54
06	*											*	6	0.34
09					*	*	*						9	0.05
12				*	*	1	*	*	*				12	
15	*			1	1	1	*	1	1	*	*	*	24	
18	*			1	1	*	*	1	1	*	*	*		
21	*			*		*		*		*		*		
Avg	*			*	*	*	*	*	*	*	*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 206

OCCURRENCE OF DUST - VOLGOGRAD, RSFSR, USSR (Feb 53 - Dec 68)

FIGURE 5 STATION 42

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.3				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	0.41
06													6	0.20
09													9	
12													12	
15	*								*				24	
18	*													
21														
Avg	*								*					
	N = 2				BLOWING DUST (visibility <11 km)									
00			*										1	1.00
03			*	*									3	0.59
06			*	*									6	0.31
09			*										9	0.12
12				*				*	*				12	0.04
15	*			*	*			1	*				24	
18	*			*	*			1						
21			*	*	*									
Avg	*		*	*	*			*	*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 207

OCCURRENCE OF DUST - VORONEZH, RSFSR, USSR (Aug 47 - Dec 68)

FIGURE 5 STATION 43

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 3				BLOWING DUST (visibility <11 km)									
00						*						*	1	1.00
03									*				3	0.50
06				*					*				6	0.31
09						*	*	*	*				9	0.03
12				*	*	1	*	*		*			12	0.02
15			*	*	*	1		*	*	*	*		24	
18			*	*		1		1	1	*	*			
21						*						*		
Avg			*	*	*	*	*	*	*	*	*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 208

OCCURRENCE OF DUST - VOZHEGA, RSFSR, USSR (Jan 48 - Dec 68)

FIGURE 5 STATION 44

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	Diurnal Variation by Month (%)												Duration Factor	
	N = 0.05				DUST STORMS (visibility <1 km)									
00													1	1.00
03													3	1.00
06													6	
09						*							9	
12													12	
15													24	
18														
21														
Avg						*								
	N = 0.8				BLOWING DUST (visibility <11 km)									
00													1	1.00
03					*				*				3	0.34
06					*				*				6	0.14
09						*					*		9	
12													12	
15												*	24	
18														
21														
Avg					*	*			*		*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 209

OCCURRENCE OF DUST - YUR'YEVETS, RSFSR, USSR (Mar 55 - Dec 68)

FIGURE 5 STATION 45

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
00													1	
03													3	
06													6	
09						NONE REPORTED							9	
12													12	
15													24	
18														
21														
Avg														
	N = 0.3				BLOWING DUST (visibility <11 km)									
00													1	1.00
03			*										3	0.65
06			*										6	0.65
09													9	
12													12	
15		*							*				24	
18		*							*					
21														
Avg		*	*						*					

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 210

OCCURRENCE OF DUST - BOLGRAD, UKRAINE, USSR (Jan 48 - Dec 68)

FIGURE 5 STATION 46

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0.1			DUST STORMS (visibility <1 km)										
02				*									1	1.00
05				*									3	0.83
08													6	0.83
11													9	0.42
14											*		12	0.42
17											*		24	
20				*										
23				*										
Avg				*							*			
	N = 1			BLOWING DUST (visibility <11 km)										
02				*			*						1	1.00
05				*									3	0.52
08													6	0.32
11									*				9	0.04
14			*	*				*	*	*	*		12	0.04
17			*	*				*	*	*	*		24	
20		*		*										
23				*		*								
Avg		*	*	*		*	*	*	*	*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 211

OCCURRENCE OF DUST - KHAR'KOV, UKRAINE, USSR (Aug 47 - Dec 68)

FIGURE 5 STATION 47

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0.1				DUST STORMS (visibility <1 km)									
02													1	1.00
05													3	1.00
08													6	
11													9	
14				*		*							12	
17													24	
20														
23														
Avg				*		*								
	N = 1				BLOWING DUST (visibility <11 km)									
02							*						1	1.00
05							*						3	0.58
08													6	0.29
11				*	*	*							9	0.06
14				1		*		*					12	
17				1									24	
20														
23														
Avg				*	*	*	*	*						

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 212

OCCURRENCE OF DUST - KIEV, UKRAINE, USSR (Aug 47 - Dec 68)

FIGURE 5 STATION 48

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Duration Factor Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
02													1	
05													3	
08													6	
11						NONE REPORTED							9	
14													12	
17													24	
20														
23														
Avg														
	N = 0.5				BLOWING DUST (visibility <11 km)									
02													1	1.00
05											*		3	0.44
08													6	0.27
11		*	*	*									9	
14			*	*									12	
17			*										24	
20														
23														
Avg		*	*	*							*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 213

OCCURRENCE OF DUST - L'VOV, UKRAINE, USSR (Jan 48 - Dec 68)

FIGURE 5 STATION 49

Hour (LST)	Diurnal Variation by Month (%) J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor Hours ≥	Decimal Percent
	N = 0.08				DUST STORMS (visibility <1 km)									
02													1	1.00
05													3	0.63
08										*			6	0.63
11										*			9	
14													12	
17													24	
20														
23														
Avg										*				
	N = 0.6				BLOWING DUST (visibility <11 km)									
02												*	1	1.00
05												*	3	0.56
08			*	*						*			6	0.49
11			*	*						*			9	
14										*			12	
17										*			24	
20		*										*		
23		*												
Avg		*	*	*						*		*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 214

OCCURRENCE OF DUST - ODESSA, UKRAINE, USSR (Feb 53 - Dec 68)

FIGURE 5 STATION 50

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0.4				DUST STORMS (visibility <1 km)									
02				*									1	1.00
05													3	0.66
08													6	0.50
11													9	0.16
14				*									12	
17				*									24	
20				*										
23				*										
Avg				*										
	N = 2				BLOWING DUST (visibility <11 km)									
02				1									1	1.00
05				1									3	0.73
08				1									6	0.48
11				1									9	0.28
14		*	*	2		*	*			*			12	0.25
17		*		3			1			*			24	0.12
20				2			*							
23				2										
Avg		*	*	2		*	*			*				

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 215

OCCURRENCE OF DUST - SARNY, UKRAINE, USSR (Jan 48 - Dec 68)

FIGURE 5 STATION 51

	Diurnal Variation by Month (%)												Duration Factor	
Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0.08				DUST STORMS (visibility <1 km)									
02													1	1.00
05													3	0.63
08													6	0.63
11													9	
14		*											12	
17		*											24	
20														
23														
Avg		*												
	N = 1				BLOWING DUST (visibility <11 km)									
02			*					*			*		1	1.00
05								*		*			3	0.54
08													6	0.25
11						*			*				9	0.16
14		*		1					*				12	
17		*		*									24	
20			*							*	*			
23			*				*	*			*			
Avg		*	*	*		*	*	*	*	*	*			

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

* <0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 216

OCCURRENCE OF DUST - SIMFEROPOL, UKRAINE, USSR (Jul 57 - Dec 68)

FIGURE 5 STATION 52

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	N = 0.5			DUST STORMS (visibility <1 km)										
02				*									1	1.00
05													3	0.73
08													6	0.73
11													9	0.19
14			*										12	
17			*										24	
20			*	1										
23			*	1										
Avg			*	*										
	N = 2			BLOWING DUST (visibility <1 km)										
02			1	1									1	1.00
05			*	1	*								3	0.72
08			1	1									6	0.45
11		*	1	1									9	0.27
14		*	1	2									12	0.19
17		*	1	2				*					24	0.07
20			1	2										
23			1	1				*						
Avg		*	1	1	*			*						

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 217

OCCURRENCE OF DUST - UZHGOROD, UKRAINE, USSR (Jan 55 - Dec 68)

FIGURE 5 . STATION 53

Hour (LST)	Diurnal Variation by Month (%)												Duration Factor	
	J	F	M	A	M	J	J	A	S	O	N	D	Hours ≥	Decimal Percent
	N = 0				DUST STORMS (visibility <1 km)									
01													1	
04													3	
07													6	
10													9	
13						NONE REPORTED							12	
16													24	
19														
22														
Avg														
	N = 1				BLOWING DUST (visibility <11 km)									
01													1	1.00
04													3	0.36
07												1	6	0.15
10												*	9	
13				*				*					12	
16		*		*									24	
19		*												
22		*												
Avg		*		*				*				*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

TABLE 218

OCCURRENCE OF DUST - ZAPOROZH'YE, UKRAINE, USSR (Jan 59 - Dec 68)

FIGURE 5 STATION 54

Hour (LST)	J	F	M	A	M	J	J	A	S	O	N	D	Duration Factor: Hours ≥	Duration Factor: Decimal Percent
	N = 2				DUST STORMS (visibility <1 km)									
02													1	1.00
05													3	0.23
08													6	0.04
11													9	
14				1									12	
17				1									24	
20				*										
23												*		
Avg				*								*		
	N = 3				BLOWING DUST (visibility <11 km)									
02				1									1	1.00
05				*									3	0.73
08				1									6	0.48
11				3									9	0.28
14			*	4					*		*		12	0.17
17			*	5									24	0.03
20			1	2										
23				2								*		
Avg			*	2					*		*	*		

N = Arithmetic mean of the annual number of occurrences of dust equal to or greater than 1-hour duration.

*<0.5%

Likelihood (%) of a visibility condition lasting for a certain period of time at a specified hour and month equals duration factor times diurnal variation by month.

APPENDIX A

Published climatological data on the occurrence of atmospheric dust over the USSR are widely dispersed in the literature. This appendix has been assembled to provide a guide to these sources of additional information. The references are listed alphabetically by author and are annotated. Where translations into English are known to exist, these are so indicated. Many of the Russian articles have been translated into English for the US Army Foreign Science and Technology Center. Copies of these translations are included in Appendix B.

The abstracts were generally taken from the Meteorological and Geophysical Abstracts (until 1960, Meteorological Abstracts and Bibliography). This abstract source is designated as MGA. A source designation of MGA 26.12-157 refers to reference number 157 in issue number 12 (December) of volume 26 (1975).

Agarkova, A. P., 1972, "Distribution and Duration of Dust Storms in Western and Southern Kazakhstan," Trudy Nauch.-Issled. Gidrometeorol. Inst. (Alma-Ata), No. 49, 110-117.

Translation: FSTC-HT-0368-76

ABSTRACT (MGA 26.7-313)

The distribution and duration of dust storms in the five oblasts of western and southern Kazakhstan were investigated on the basis of data for 21 stations. Dust storms occur most often during the period from April to October in which 92-96% of all dust storms of the Ural oblast belong, 77% of all dust storms of the Aktyubinsk oblast, 78% of all dust storms of the Kzyl-Ordinsk oblast, and 85% of all dust storms of the Chimkentsk oblast. In Kzyl-Ordinsk and Chimkentsk oblasts, and also in the south of the Aktyubinsk and the east of the Gur'yev oblasts, dust storms may develop during the entire year. A sharp rise in the number of days with dust storms in the course of the year is observed in April, when the maximum number of dust storms occurs over a large part of the Gur'yev oblast. In Aktyubinsk and Kzyl-Ordinsk oblasts, the maximum is shifted to May, and in the Ural oblast to the summer months. The most protracted dust storms were noted during the cold months of the year, mainly in November through December, and in the northwestern and southeastern parts of the Gur'yev oblast in February.

Babichenko, V. N., 1965, "Dust Storms in the Ukraine," Trudy Nauch.-Issled. Gidrometeorol. Inst. (Kiev), No. 52, 45-53. (AD A008 263)

Translation: FSTC-HT-23-0406-74

ABSTRACT (MGA 17.11-353)

The author examines the problem of the frequency of dust storms in the Ukraine, their duration, intensity, and daily and annual variations. Particularly intense dust storms are described individually. Data are presented on the mean monthly number of days with dust storms, on probability of occurrence of dust storms at different times of day, and on the probability of dust storms of varying duration. Charts with isolines of the mean number of days per year with dust storms and the maximum number of days with dust storms are given.

Babichenko, V. N. and M. Yu. Kulakovskaya, 1970, "Winter Dust Storms in the Ukraine," Trudy Nauch.-Issled. Inst. (Kiev), No. 91, 106-121.

Translation: FSTC-HT-23-1857-75

ABSTRACT (MGA 23.4-358)

On the basis of observations of 185 meteorological stations in the Ukraine for 1935 to 1969, the mean and maximum long-period number of days with dust storms was calculated in different regions of the Ukraine in the months of December, January, and February, and in the December through February interval, as was the frequency of the number of days with dust storms in individual years for the aforementioned months. The meteorological conditions during dust storms are examined and the dependence of the number of days with dust storms and their duration upon windspeed is shown to be characterized by a straight line. Dust storms were found to be most frequent almost every winter in the Zaporozh'e oblast. A dust storm that occurred in January and one that occurred in February 1969 are described.

Borushko, I. S., 1972, "Dust Storm Distributions in the Tropics," Trudy Glav. Geofiz. Obs. (Leningrad), No. 284, 76-83. (AD B013 599)

Translation: FSTC-0369-76

ABSTRACT (MGA 26.2-343)

Data on the frequency of the number of days with dust storms by season and year in Australia and on the mean monthly and annual number of days with dust storms by month and year in the tropical zones of Asia, Africa, and Australia are given in tables and maps. The relationship between the number of days with dust storms and intense wind (greater than 16 m/sec) was found to be close in deserts, while in semideserts the distribution of dust storms in the course of the year is determined mainly by precipitation. The structure of the underlying surface was found to be an important factor in the occurrence of dust storms.

Bova, N. V., 1957, "Dust Storms in the Transvolga," Meteorol. Gidrol. (Leningrad), No. 12, 29-31. (AD 784 174)

Translation: FSTC-HT-23-0415-74

ABSTRACT (MGA 10.7-245)

With the increasing cultivation of sandy and clayey-sandy soils in the semiarid regions during recent years, new centers of wind erosion have arisen. On the basis of a 20-year record (1936-1955), the author analyzes the frequency and characteristics of dust storms in the Saratov oblast. Data are presented on the mean monthly number of days with strong dust storms and the mean and maximum number of days for April through October, the frequency (in percent) of storms at different times of day and their duration in hours and on the weather associated with dust storms. The average number of days with dust storms is 5 to 6 and 13 to 15 during drought years. Dust storms are most frequent in the summer. Mean duration of a dust storm is 1 to 3 hours. Dust storms are closely associated with dry weather, particularly with sukhovei winds.

Chirkov, Yu. I., 1970, "Frequency of Dust Storms in the USSR and the Possibility of Predicting their Formation," Trudy Gidrometeorol. Nauch.-Issled. Tsentr. SSR (Moscow), No. 69, 109-119. (AD B013 731)

Translation: FSTC-HT-1856-75

ABSTRACT (MGA 23.5-378)

The factors causing dust storms in the USSR are discussed. The characteristics of the zones in which they occur are summarized, and the distribution of the number of days per year with dust storms in the principal agricultural regions is shown on a map. The winter dust storms for 1969 are analyzed. The effect of the state of the soil, the development of plantings, and the forest cover of a region upon the degree of damage to plantings are analyzed. Agrometeorological predictions of the formation of dust storms are presented.

Dolgilevich, M. I., 1966, "Dust Storms of the Ukraine," Izv. Akad. Nauk SSSR, Ser. Geograph. (Moscow), No. 1, 34-40 (AD A001 224)

Translation: FSTC-HT-23-0028-74

ABSTRACT (MGA 17.8-380)

The regional distribution of dust storms in the Ukraine, their seasonal frequency, and the laws of the genetic relationship between natural factors causing dust storms and their intensity are examined on the basis of data provided by 178 weather stations for 1943 to 1962. The article contains maps giving the distribution of the number of days with dust storms over the Ukraine (20-year period), the distribution of the number of days with dust storms in the natural zones of the Ukraine in the course of a year, the number of days with dust storms in spring (over 20 years), the number of days with intense winds in spring in the Ukraine (mean annual) and soil moisture supplies in arable land in the spring of 1960, and a graph giving the monthly number of days with dust storms in the different natural zones of the Ukraine. The water supplies in the soil were a major factor in the formation of dust storms - low moisture supplies combined with strong persistent winds cause the blowing away of soil.

Dolgilevich, M. I. and A. N. Sazhin, 1973, "Dust Storms in West Sibëria," Izv. Akad. Nauk SSSR, Ser. Geograf. (Moscow), No. 6, 83-88. (AD B009 108)

Translation: FSTC-HT-23-1106-75

ABSTRACT (MGA 25.10-293)

The number of days with dust storms in West Siberia averages 0.2 to 34 per year. This maximum number of days with dust storms is observed in the dry and northern steppe of Kulunda. The duration of dust storms (in hours) per year corresponds to the mean number of days with dust storms; the relationship between them is characterized by a correlation of 0.93. The mean wind velocity during dust storms is 5.4 to 12.9 m/sec and the maximum, 11 to 46 m/sec. Over a large part of the forest steppe and steppe zones of West Siberia, there are 20 to 30 days with strong winds per year; in the region of Kulunda, Central Baraba, and in the North of the Pre-Ob plateau, there are up to 40 days of strong winds per year. The critical velocity for the initiation of wind erosion of the soil is 6 to 12 m/sec and, for the principal soil types, 8 to 9 m/sec. With increase in the frequency of critical windspeeds, the number of days with dust storms increases; these variables have a correlation of 0.82 to 0.96. Dust storms arise most often during southwesterly winds whose frequency is 10% to 52%. Atmospheric temperature during dust storms varies, within wide limits, from -5° or -7°C to +35° or +40°C; and relative humidity, from 10% to 75%. Data on the mean, long-period values of the meteorological elements characterizing dust storms, the number of dust storms during the observation period, duration of dust storms (in hours), frequency of dust storms of different wind velocities (1940-1970), etc., at individual locations are given in tables and maps.

Kukis, S. I., 1968, "Dust Storms in the Altay Territory," Meteorol. Gidrol. (Moscow), No. 12, 74-79. (AD 783 664)

Translation: FSTC-HT-23-0414-74

ABSTRACT (MGA 20.12-315)

This paper discusses the nature of dust storms in the Altai Region. Certain qualitative characteristics of the dust storms are presented, namely, their frequency per month and their duration according to the time of formation at different hours of the day or with different windspeeds. Conclusions are also given regarding the characteristics of dust storms and their tendencies in this region. These conclusions suggest that dust storms occur in this steppe region every year mainly between April and October, with the greatest number in May and June. They form principally between 0800 and 1500 hours and last from half an hour to 24 hours. Dust storms do not occur with windspeeds up to 5 m sec^{-1}.

Romushkevich, V. I., 1967, "The Frequency of the Most Intense Dust Storms in the Ukraine," Meteorol. Gidrol., Informat. Bull. (Kiev), No. 12, 111-115 (AD 784 101)

Translation: FSTC-HT-23-0139-74

ABSTRACT

Data are reported on the frequency of dust storms in the Ukraine. During the dust storms, windspeeds exceed 14 m sec^{-1}. A small-scale map portrays the probability of the occurrence of storm winds in the republic. Three areas are shown in which the probability of frequent dust storms is very high: the eastern steppe region, the large central plains area (including the Crimean steppe area), and the southwestern region in the southern part of the Odessa area. Storm winds capable of causing dust storms occur at any time of the year, but are most frequent in March, April, and the summer months; they are least frequent in January. Of the total number of dust storms occurring during the period studied, 88% occurred during east winds, 22% during northeast winds, and 3% during southeast winds. Only 9% of the dust storms occurred during west winds.

Sapozhnikova, S. A., 1970, "Map Diagram of the Number of Days with Dust Storms in the Hot Zone of the USSR and the Adjacent Territories," Trudy Nauch.-Issled. Inst. Aeroklimatol. (Leningrad), No. 65, 61-68. (AD 784 100)

Translation: FSTC-HT-23-0027-74

ABSTRACT (MGA 22.11-360)

The author presents a map of the USSR showing the boundary of the black soil zone, the hot zone and its various regions, stable snow cover, and the mean number of days with dust storms in the hot zone. Against the background of a definite zonation in the increase of dust storms with the increase in climatic aridity (from single days in the north of the black soil zone to 40 or more days in the Kara-kum), their distribution manifests a patch character. This indicates that local conditions of soil cover properties and anthropogenic factors play a large role in the formations of dust storms. A table gives the number of days per year with dust storms in cities and outside cities.

Seredkina, E. A., 1960, "Dust Storms in Kazakhstan," Trudy Nauch.-Issled. Gidrometeorol. Inst. (Alma-Ata), 15, 54-59.

Translation: FSTC-HT-23-1130-73

ABSTRACT (MGA 13.6-562)

Data are presented on the maximum number of days with dust storms per year, the daily variation of dust storms during the period 1951 to 1955, the frequency of dust storms of different duration at different points in Kazakhstan (1951 to 1955), and direction and wind velocity near the dust storms; maps showing synoptic situations associated with dust storms are included. The author established that dust storms arise on the periphery of high-altitude cyclones and anticyclones where the surface isobars and the high-altitude isohypses are parallel.

Zakharov, P. S., 1966, "The Characteristics and Geographical Distribution of Dust Storms," Meteorol., Klimatol., Gidrol. Mezhvedom. Nauch. Sbornik (Kiev), No. 2, 19-23. (AD 770 736)

Translation: FSTC-HT-23-1131-73

ABSTRACT (MGA 18.11-356)

The dust or black storms which are observed frequently in arid regions are described and a map showing their frequency in the agricultural zone of the USSR is presented. The strong winds which exceed 15 m sec^{-1} destroy and blow away the top soil and greatly damage agriculture. The actual dust storms are to be distinguished from advective storms which form as a result of dust transported by winds in regions located in the boundaries of soil blowing. These storms are characterized by air saturated with fine grains so that visibility is low; neither soil nor plantings are blown away in the region of observation, and the wind is less than 15 m sec^{-1}. The wind regime in the steppe zone and southern part of the USSR where the actual dust storms occur is described. The greatest number of dust storms occur in Kazakhstan, in the virgin land region (50 to 60 days per year); second in number of dust storms (20 days per year) is southern Kurstana on the Turgai Plateau. In the southern part of the USSR, the mean number of days with dust storms per year does not exceed 10.

Zhirkov, K. F., 1964, "Dust Storms in the Steppes of Western Siberia and Kazakhstan," Izv. Akad. Nauk SSSR, Ser. Geograf. (Moscow), 5, 33-41. (English edition)

ABSTRACT

The author analyzes the occurrence of dust storms in terms of frequency during time of year and time of day, duration, and the specific synoptic conditions under which they occur. He urges more detailed study of the origin of dust storms as a basis for a system of control measures designed to protect crops.

APPENDIX B

Appendix B is a compilation of English language translations of published Russian language articles on the climatology of dust storms over various geographical regions of the USSR which have been made available through the US Army Foreign Science and Technology Center. These translations are presented in this appendix in alphabetical order by author.

Agarkova, A. P., 1972, "Distribution and Duration of Dust Storms in Western and Southern Kazakhstan," Trudy Nauch.-Issled. Gidrometeorol. Inst. (Alma-Ata), No. 49, 110-117.

Considerable attention has been devoted to the question of the effect of wind on soils with various structures. Wind erosion of soils, or deflation, is the process of destruction of soil under the influence of a stream of air. Dust, sand, or black storms are some of the ways in which wind erosion manifests itself.

A dust storm is understood to be a phenomenon in which a large amount of dust, sand, and particles of earth is raised into the air by a strong wind, as a consequence of which the atmosphere becomes turbid and visibility deteriorates.

Many domestic and foreign works [1-9, etc.] have been devoted to the study of dust, sand, and black storms. Dust storm conditions in individual regions of Kazakhstan have been given attention in the works of N. N. Romanov, Ye. A. Seredkina, and L. P. Fedyushina [6,8,9].

The question of distribution and duration of dust storms in five regions of Western and Southern Kazakhstan is examined. A period of time (in the course of a day) has been found during which dust storms develop most often, and their duration has been analyzed. The investigation was performed with observational data from 21 meteorological stations over a period of 20 years (1950-1969). The initial data were the data of TM-1 tables and weather records.

In Western and Southern Kazakhstan, 10,701 station-days with dust storms were observed in the 20 years studied. Their distribution during the year by regions is given in Table 1. Interpretation of the data from the table shows that in 85% of the cases dust storms in the territory studied developed from April through September, i.e., during the warm period of the year, and only in 15% of the cases in the cold period (October-March). In April, compared with the preceding months, the number of days with a dust storm increased sharply, the maximum arrived in June (15.8%), a sharp decrease from September was observed in October, and in January a minimum was noted.

In each region, as a consequence of differences in the soils and vegetative cover, the annual course of dust storms differs significantly from the annual course over the entire area, i.e., the maximum and minimum can shift to other months. Thus, in the Ural'sk region, the maximum number of days with dust storms (531) occurs in July and the minimum in February, but in the Chimkent region, in August and December, respectively (Table 1).

TABLE 1

DISTRIBUTION OF NUMBER OF STATION-DAYS WITH DUST STORMS
BY REGIONS OF WESTERN AND SOUTHERN KAZAKHSTAN

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Apr-Sep	Oct-Mar
Ural'sk	4	0	3	140	423	519	531	513	385	150	15	11	2694	2511	183
Gur'yev	32	60	164	427	346	286	269	252	231	157	84	53	2361	1811	550
Aktyubinsk	1	3	33	254	391	381	381	315	276	157	77	30	2299	1998	301
Kzyl Orda	14	22	50	150	177	146	122	124	136	88	40	22	1091	855	236
Chimkent	16	30	79	214	289	361	367	382	312	143	49	14	2256	1925	331
Total	67	115	329	1185	1626	1693	1670	1586	1340	695	265	130	10701	9100	1601
%	0.6	1.1	3.1	11.1	15.2	15.8	15.6	14.8	12.5	6.5	2.5	1.2	100	85.0	15.0

There is a difference in manifestation of dust storms within each region. To determine the characteristic features of their origin, the distribution (number of days and percent) of dust storms during the year in each region, as well as in the area of each station, is given in Table 2.

In the Ural'sk region, dust storms were observed predominantly from April through October inclusive (Table 2). In November-January and in March, they did not occur universally; and in February, they were not observed at all in the entire region in 20 years.

In the warm period of the year (April-September), 92-96% of the cases occurred and in the cold period only 4-8%. A sharp increase in dust storm activity was observed in April and May and a weakening in October and November. The maximum development over the region occurred in July, but there also was quite a large percentage in June and August. At individual stations, they extended from May through August. Thus, in the Ural'sk region, the maximum (19.7%) development of dust storms was observed in May, in Kalmykovo and Dzhambeyti (20.7 and 19.6%, respectively) in June, in Kazakhstan and Furmanovo (19.9 and 24.3%) in July, and in Urda (23.1%) in August. The most frequent development of dust storms was observed in the north of the region, in the area of the Kazakhstan station (941 cases) and the least frequent in Urda (52).

The maximum duration of storms in the year varies by station, from 18 to 72 hours (Table 3). Their maximum duration is from 18 to 38 hours in the warm period of the year and from 9 to 72 hours in the cold period. The longest dust storm was observed in the north of the region in 1966. It lasted from 9:30 a.m. 17 December to 10:00 a.m. 20 December, with an air temperature of -16 to 24 degrees and windspeeds up to 16-18 m/sec, from the east and southeast.

In the Gur'yev region, about 77% of all cases of development of dust storms occur in the warm period of the year and about 23% in the cold period (Table 2). At individual stations the percentage varies from 67 to 83 in the warm period and from 17 to 33 in the cold period.

In contrast to the Ural'sk region, storms are observed during the entire year over the entire territory. The number of dust storms increases sharply in April and reaches a maximum in the greater part of the region. A gradual decrease is observed in the succeeding months, to a minimum in January. In the southeast of the region (Duken, Sam, and Ak-Kuduk), the minimum occurs in November or December.

Dust storms are observed most often in the eastern part of the region, in the area of Koschagyl, where the number of days is 1-1/2 to 6 times greater than in the western and southern portions of the region (in Duken and Ganyushkino).

TABLE 2

DISTRIBUTION OF DUST STORMS BY STATION
(upper, number of days; lower, percent)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Apr-Sep	May-Mar
Ural'sk Region															
Kazakhstan	1	0	0	45	169	170	187	175	131	48	7	8	941	877	64
	0.1	0	0	4.8	18.0	18.1	19.9	18.6	13.9	5.1	0.7	0.8	100	93.2	6.8
Dzhambeyti	1	0	0	32	105	130	128	121	97	45	3	2	664	613	51
	0.2	0	0	4.8	15.8	19.6	19.3	18.2	14.6	6.8	0.5	0.3	100	92.3	7.7
Ural'sk	0	0	0	11	48	47	47	45	31	13	2	0	244	229	15
	0	0	0	4.5	19.7	19.3	19.3	18.4	12.7	5.3	0.8	0	100	93.9	6.1
Furmanovo	1	0	0	7	33	60	74	66	51	13	0	0	305	291	14
	0.3	0	0	2.3	10.8	19.7	24.3	21.6	16.7	4.3	0	0	100	95.3	4.6
Kalmykovo	1	0	1	40	59	101	87	94	70	31	3	1	488	451	37
	0.2	0	0.2	8.2	12.1	20.7	17.8	19.3	14.3	6.4	0.6	0.2	100	95.4	7.6
Urda	0	0	2	5	9	11	8	12	5	0	0	0	52	50	2
	0	0	3.8	9.6	17.3	21.2	15.4	23.1	9.6	0	0	0	100	96.2	3.8
Region total	4	0	3	140	423	519	531	513	385	150	15	11	2694	2511	183
	0.2	0	0.1	5.1	15.7	19.3	19.7	19.0	14.3	5.6	0.5	0.4	100	93.2	6.8
Gur'yev Region															
Ganyushkino	10	16	24	107	106	65	59	55	59	33	14	14	562	451	111
	1.8	2.8	4.3	19.0	18.9	11.6	10.5	9.8	10.5	5.9	2.5	2.5	100	80.2	19.8
Gur'yev, main agrometeorological station	1	4	25	86	61	43	47	41	61	41	10	9	429	339	90
	0.2	0.9	5.8	20.0	14.2	10.0	11.0	9.6	14.2	9.6	2.3	2.1	100	79.0	21.0
Koschagyl	5	12	67	140	123	108	104	90	65	46	48	22	830	630	200
	0.6	1.4	8.1	16.9	14.8	13.0	12.5	10.8	7.8	5.5	5.8	2.7	100	75.9	24.1
Sam	7	14	19	40	25	29	20	22	15	15	6	3	215	151	64
	3.3	6.5	8.8	18.6	11.6	13.5	9.3	10.2	7.0	7.0	2.8	1.4	100	70.2	29.8
Duken	4	3	2	15	15	27	16	24	18	9	2	3	138	115	23
	2.9	2.2	1.4	10.9	10.9	19.6	11.6	17.4	13.0	6.5	1.4	2.2	100	83.3	16.7
Ak-Kuduk	5	11	27	39	16	14	23	20	13	13	4	2	187	125	62
	2.7	5.9	14.4	20.9	8.6	7.5	12.3	10.7	7.0	7.0	2.1	1.1	100	66.8	33.2
Region total	32	60	164	427	346	286	269	252	231	157	84	53	2361	1811	550
	1.4	2.5	6.9	18.1	14.7	12.1	11.4	10.7	9.8	6.6	3.6	2.2	100	76.7	23.3

Table 2 (cont)

							Aktyubinsk Region								
Aktyubinsk	0	0	0	48	89	83	71	52	48	18	3	6	418	391	27
	0	0	0	11.5	21.3	20.0	17.0	12.4	11.5	4.3	0.7	1.4	100	93.5	6.5
Temir, City	0	0	0	29	88	96	112	91	74	31	5	4	530	490	40
	0	0	0	5.5	16.6	18.1	21.1	17.1	14.0	5.8	0.9	0.8	100	92.5	7.5
Chelkar	1	3	33	177	214	202	198	172	154	108	69	20	1351	1117	234
	0.1	0.2	2.4	13.1	15.8	15.0	14.7	12.7	11.4	8.0	5.1	1.5	100	82.7	17.3
Region total	1	3	33	254	391	381	381	315	276	157	77	30	2299	1998	301
	0.04	0.1	1.4	11.0	17.0	16.6	16.6	13.7	12.0	6.8	3.3	1.3	100	86.9	13.1
							Kzyl Orda Region								
Dzhusaly	12	14	26	81	89	67	61	54	57	38	17	16	532	409	123
	2.2	2.6	4.9	15.2	16.7	12.6	11.5	10.2	10.7	7.1	3.2	3.0	100	76.9	23.1
Kzyl Orda	2	8	24	69	88	79	61	70	79	50	23	6	559	446	113
	0.4	1.4	4.3	12.3	15.7	14.1	10.9	12.5	14.1	8.9	4.1	1.1	100	79.8	20.2
Region total	14	22	50	150	177	146	122	124	136	88	40	22	1091	855	236
	1.3	2.0	4.6	13.7	16.2	13.4	11.2	11.4	12.5	8.1	3.7	2.0	100	78.4	21.6
							Chimkent Region								
Turkestan	3	4	17	37	45	47	48	52	61	31	12	1	358	290	68
	0.8	1.1	4.7	10.3	12.6	13.1	13.4	14.5	17.0	8.7	3.4	0.3	100	81.0	19.0
Kzylkum	11	20	48	102	123	134	131	140	99	40	16	5	869	729	140
	1.3	2.3	5.5	11.7	14.2	15.4	15.1	16.1	11.4	4.6	1.8	0.6	100	83.9	16.1
Achisay	1	3	5	29	21	36	43	57	62	16	7	7	287	248	39
	0.4	1.0	1.7	10.1	7.3	12.5	15.0	19.9	21.6	5.6	2.4	2.4	100	86.4	13.6
Arys	1	3	9	46	100	144	145	133	90	56	14	1	742	658	84
	0.1	0.4	1.2	6.2	13.5	19.4	19.5	17.9	12.1	7.5	1.9	0.1	100	88.7	11.3
Region total	16	30	79	214	289	361	367	382	312	143	49	14	2256	1925	331
	0.7	1.3	3.5	9.5	12.8	16.0	16.3	16.9	13.8	6.3	2.2	0.6	100	85.3	14.7

TABLE 3

MAXIMUM DURATION OF DUST STORMS
(hours)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Apr-Sep	May-Mar
Kazakhstan	7	0	0	19	20	19	17	34	18	16	15	72	72	34	72
Dzhambeyti	2	0	0	12	14	30	34	24	19	17	9	4	34	34	17
Ural'sk	0	0	0	7	10	22	13	13	6	4	5	0	22	22	5
Furmanovo	3	0	0	9	14	9	10	18	14	9	0	0	18	18	9
Kalmykovo	11	0	0	16	10	17	12	11	25	7	10	3	25	25	11
Urda	0	0	9	29	38	7	10	6	10	0	0	0	38	38	9
Ganyushkino	33	63	31	34	60	11	11	15	10	22	12	31	63	60	63
Gur'yev, main agrometeorological station	1	33	26	29	61	10	10	16	23	11	14	12	61	61	33
Koschagyl	14	17	72	54	64	21	28	23	28	33	109	75	109	64	109
Sam	17	63	36	13	16	11	9	11	11	12	17	3	63	16	63
Duken	15	19	13	10	8	3	5	8	4	8	9	12	19	10	19
Ak-Kuduk	4	16	22	17	12	6	5	10	6	18	5	3	22	18	22
Aktyubinsk	0	0	0	20	12	16	7	13	16	7	7	8	20	20	8
Temir, City	0	0	0	15	18	16	24	16	30	10	31	8	31	30	31
Chelkar	8	8	46	60	42	24	44	31	35	44	36	80	80	60	80
Dzhusaly	32	18	24	58	22	16	10	8	10	11	20	60	60	58	60
Kzyl Orda	4	12	15	12	14	10	11	12	16	10	30	24	30	16	30
Turkestan	12	10	7	12	18	6	8	10	8	10	27	2	27	18	27
Kzylkum	34	40	28	36	28	18	37	40	38	19	22	10	40	40	40
Achisay	1	13	23	42	18	71	58	38	51	35	81	43	81	71	81
Arys	3	2	7	10	15	13	15	47	14	15	9	1	47	47	15

The maximum duration of dust storms varies by station, from 19 to 109 hours during the year and during the cold period of the year and from 10 to 64 hours in the warm period. The longest storms are in the northwestern (Ganyushkino) and southeastern portions of the region (Sam, Duken) in February, in Gur'yev in May, and in Koschagyl in November.

In the Aktyubinsk region, development of storms is observed from April to December inclusive (at the Aktyubinsk and Temir stations) and during the entire year in Chelkar. Eighty-seven percent of all the cases occur in the warm period (Table 2) and only 13% in the cold period. Ninety-two to 94% of the cases occur in the warm period in Aktyubinsk and Temir and about 83% in Chelkar.

As in the Gur'yev and Ural'sk regions, a sharp increase in number of days of storms in the course of the year is observed in April. The maximum shifts to May and in Temir to July; the minimum occurs in January (0.04%).

The maximum duration of storms varies during the year from 20 to 80 hours, from 20 to 60 hours in the warm period, and from 8 to 80 hours in the cold period (Table 3). The longest dust storm (about 80 hours) was observed in Chelkar in the 17 to 20 December 1966 period.

In the Kzyl Orda region, dust storms occur in all months of the year. About 78% of them occur in the warm period and about 22% in the cold. As in the Aktyubinsk region, the maximum number of days with dust storms occurs in May and the minimum in January (Table 2). The longest dust storms are in Dzhusaly, up to 58 hours in April and up to 60 hours in December (18 to 20 December 1966).

In the Chimkent region (in the central and southern parts of it), as in the Kzyl Orda region, dust storms occur during the entire year (Table 2). In 85% of the cases, they are observed in the warm period and about 15% in the cold. As in the other regions, the number of storms increases sharply in April and decreases in October. Their maximum frequency (16.9%) occurs in August. However, in individual areas of the region, the maximum does not occur simultaneously. Thus, in the south (in Arys), the maximum is observed in July, in Kzylkum in August and in Achisay and Turkestan in September. The minimum frequency of 0.1-0.6% occurs in December-January.

The maximum duration of storms is 27 to 81 hours in the year and during the cold period of the year and 18 to 71 hours in the warm. The longest storms in the warm (June) and the cold (November) times of the year were observed in Achisay. Thus, a dust storm lasted 71 hours in the 11 to 14 June 1958 period and 81 hours 19 to 23 November 1951.

The following conclusions should be drawn from what has been stated above.

1. The development of dust storms is observed during the entire year in the Chimkent and Kzyl Orda regions, as well as in the south of the Aktyubinsk and in the east of the Gur'yev regions.

2. They occur most often in Chelkar, Aktyubinsk region, in the area of the Kazakhstan station in the north of the Ural'sk, in Koschagyl in the east of the Gur'yev, and in the Kzylkum and Arys in the southwest and south of the Chimkent regions.

3. The longest dust storms are observed in the cold time of the year, predominantly in November and December, but in February in the northwest and southeast of the Gur'yev region.

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This article discusses recurrence of dust storms in the Ukraine, their duration, intensity, and daily and annual rate. The great number of occurrences of this phenomenon are described separately.

The effects of harmful phenomena in the weather, such as droughts, dry winds, dust storms, night frosts, ice crusts, hail damage, etc., periodically result in severe damage to the national economy.

A comprehensive study of these phenomena makes it possible to develop measures for combating their harmful consequences successfully.

Dust storms have severely damaged agriculture in the south of the Ukraine, particularly in some years.

Until now, the descriptions of individual occurrences of dust storms [2-6, 9, 12, 13, 16, 20, 24-26, 30-32] do not solve the problem as a whole, and are normally devoted to certain aspects of this occurrence. No climatic work has yet been done on dust storms for the whole territory of the Ukraine.

Dust, or black, storms occur when there is a strong wind during dry weather as a result of the dispersion of pulverized soil on fields [19, 23]. Important conditions for this are the appropriate mechanical composition of the soil, the extent to which the soil has been dried, and the condition of the vegetation cover.

Large amounts of dust in the air can also occur over relatively large areas when there is much traffic on earthen roads, for example during harvest time.

The speed of the wind, as is well known, plays an important part in the formation of dust storms.

In respect to what has been said, a geographic determination of the annual rate of dust storms is distinctive. According to material which was processed on the Ukraine, which included the period from 1936 until 1963, the main sources of dust storms are in the southwest and the south, and are usually observed from March until September. In winter, dust storms occur only rarely, perhaps once or twice every 10 years, and then only in the south and east of the Republic (Table 1). One such storm erupted on the 11-14 December 1946 over a large area of the Ukraine. It was accompained by a strong east wind with gusts of up to 30 m/sec.

Horizontal visibility was reduced to 100 m because of the dust in the air. In some places (Kirillovka, Gulyaypole and others) heaps of earth 1 m in height were formed, and in many other places winter crops were blown away.

A strong black storm was also recorded in the winter of 1951, from 28 February to 1 March.

The most intense and dangerous spring black storms occur during a prolonged drought, when the soil is dry and vegetation is not fully developed and does not form a continuous cover. At this time, storms blow away crops over large areas.

In 1892, a dust storm was observed in the south of the Ukraine from 28 April until 5 May and was investigated and described by Professor S. G. Popruzhenko. During this storm all the shoots in fields and kitchen gardens were sprinkled with dust, leaves on the trees were sown with particles of sand, the wind blew down large areas of crops and caused drifts of sands on the Donets Railroad [30, 31, 32].

This is how Popruzhenko describes the effect of this storm:

> "A dry, strong east wind tore at the earth for several days and drove along masses of sand and dust. Crops, yellowing from the dry air were uprooted as with a sickle and even the roots did not survive. The earth was removed to a depth of 18 cm. Ditches were filled up to 1.5 m. The central part of the former Berdyansk district suffered most severely. The aftermath of the storm: 98,000 hectares of crops (winter and spring) were destroyed in the district. In the former Mariupol'sk district 165,000 hectares were flattened - more than one-third of the spring and more than one-half of the winter crops."

A dust storm on 26-28 April 1928 also caused large devastation over a wide area [11, 12]. It covered the whole of the steppe and part of the forest-steppe. The wind raised more than 15 million tons of black earth dust from an area of one million square kilometers to a height of 400-750 meters. Large amounts of pulverized soil settled partially on the Ukraine, partially in Rumania and Poland. The area over which the dust fell (here and abroad) was 6 million square kilometers. The storm caused much damage since the soil at that time was dry and not covered by vegetation. In some places spring crops were torn from their roots. The depth of soil blown away was 12 cm and in some instances 25 cm. Large drifts of earth formed on railroads; in many places telegraph poles and fences were uprooted, roofs were torn from houses, etc.

During a dust storm from 29 to 31 March 1949 in the south of the Ukraine, the wind reached a speed of 25 m/sec and visibility was reduced to 50 m. Winter crops were damaged considerably; for example, in the Askanin-Nova, Novo-Alekseyevka, Berislav regions, the top layer of the soil was blown away. Similar dust storms were observed in 1948 from 10 to 12 April and in 1953 from 3 to 5 April.

One must remember the exceptional dust storms in March and April 1960. The first (from 18 to 23 March) covered the Zaporozh'ye and Kherson districts, the steppe areas of the Crimea and the south of the Nikolaev and Donets districts. The April storms lasted from the 3rd to the 10th, and afterwards from the 12th to the 18th. They spread over the whole of the Nikolayev and Donets and also the Odessa, Dnepropetrovsk, Poltava, Khar'kov and Lugansk districts. Dust storms were accompanied by a storm wind from the east and southeast with a speed of 16-18 m/sec, with gusting of up to 40 m/sec. When there is little moisture, strong winds dry the upper levels of the soil quickly. In some places the visibility was reduced to 50-100 m. During this time, the dust-laden layer of the atmosphere reached a height of 1200-1300 m, particles of soil were carried beyond the borders of the Ukraine to Rumania and Poland. As we have already said, fields which were not covered by vegetation were subject to soil erosion. In a number of places, crops were replanted two or three times because of the wind. Winter crops suffered the same as spring crops.

In forest areas, stretching from the north to the south, that is, across the direction of the prevailing wind during the storm, the height of the drifts was 2-3 m.

Synoptic processes which caused this weather in March and April 1960 are very similar to each other. There was slow-moving depression above the Black Sea for a long time and an anticyclone over the European territory of the Soviet Union. The only basic differences were in the nature of the processes over the European territory of the Soviet Union: in March, the anticyclones moved from Scandinavia southeast over the European territory of the Soviet Union, and in April they were stationary over it [4, 24, 26].

Observations over a long period of years show that dust storms are a frequent phenomenon in arid years and when there are dry winds. Dust storms occurred frequently in 1828, 1837, 1848, 1877, 1885, 1886, 1892, 1898, and 1899. Over the past 30-year period, dust storms have appeared in 1928, 1929, 1930, 1936, 1946, 1948, 1949, 1953, and 1960. Some of them were quite significant in strength and duration.

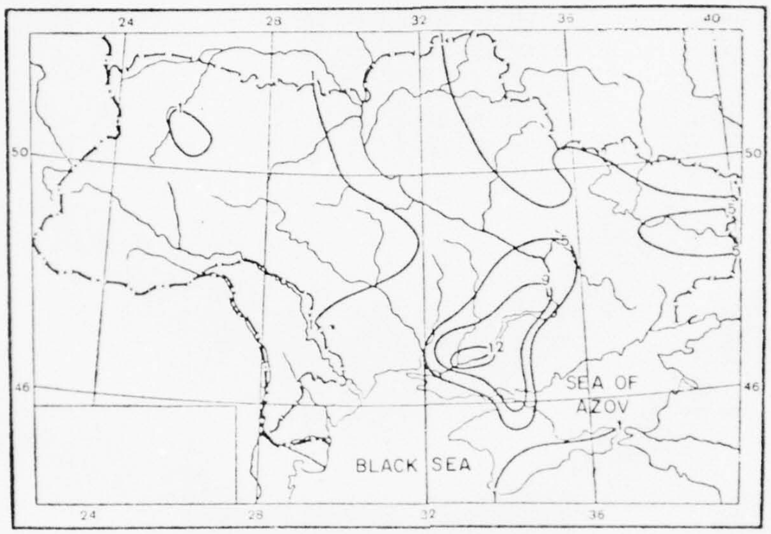

Figure 1. The average annual number of days with dust storms.

Apart from the frequency and annual rate of dust storms (Table 1), a map has been compiled for the average annual number of days with dust storms (Figure 1). The figure shows that there are more dust storms in the southeast than in the northwest part of the Ukraine. The storms are seen most frequently in the steppe. In the forest-steppe there is also a fairly high number of dust storms in the Pridneprovsk Valley, and in wooded areas they are more frequent in the watersheds of rivers.

Dust storms are unknown in the Carpathians and beyond them.

The frequency of dust storms varies greatly from year to year. On the average, the maximum annual number occurs in the steppe of the Ukraine, especially in the region of Zaporosh'ye interior plain. Here the maximum number was 36 days per year and the mean was nine days per year. The greatest number of days with a dust storm in individual years in Verkhnedneprovsk was 36; in Berislav, 33; in Kherson, Novo-Alekseyevka, and Nikolayev, 27. In the western woodlands and forest-steppe, the maximum annual number of days with dust storms is 1-5, and in the remaining territory approximately 10 (Figure 2).

TABLE 1

AVERAGE NUMBER OF DAYS WITH DUST STORMS

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Uzhgorod	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L'vov	0.0	0.0	0.0	0.0	0.06	0.06	0.1	0.1	0.06	0.0	0.0	0.0	0.4
Kovel'	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.06	0.1	0.0	0.0	0.3
Vinnitsa	0.0	0.0	0.0	0.0	0.2	0.4	0.2	0.0	0.1	0.0	0.0	0.0	0.9
Bolgrad	0.06	0.2	0.2	0.8	0.7	0.3	0.9	1.0	1.0	0.8	0.1	0.0	6.1
Razdel'naya	0.0	0.04	0.2	1.0	0.2	0.5	0.5	1.0	0.5	0.1	0.04	0.0	4.1
Kiev	0.0	0.0	0.04	0.2	0.6	0.6	0.3	0.2	0.1	0.0	0.0	0.0	2.0
Zolotonosha	0.0	0.08	0.0	0.2	0.2	0.2	0.3	0.5	0.1	0.04	0.0	0.0	1.6
Znamenka	0.0	0.0	0.0	0.7	0.5	0.6	0.7	0.7	0.1	0.1	0.0	0.0	3.4
Kherson	0.0	0.0	0.4	1.6	2.1	1.2	1.5	1.5	1.4	0.8	0.05	0.1	10.6
Berislav	0.0	0.2	0.2	2.0	2.0	1.3	1.5	2.9	1.8	0.4	0.2	0.1	12.6
Khutor Mikhaylǒvskiy	0.0	0.0	0.0	0.0	0.0	0.05	0.0	0.0	0.0	0.0	0.0	0.0	0.05
Sumy	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.7
Klepinino	0.0	0.2	1.2	1.2	0.6	0.2	1.1	1.2	1.0	0.2	0.0	0.0	6.9
Verkhnedneprovsk	0.0	0.2	0.06	0.8	0.9	0.8	1.1	1.1	1.1	0.3	0.07	0.0	6.4
Dnepropetrovsk	0.0	0.0	0.0	1.3	0.8	0.6	0.6	0.5	0.4	0.1	0.05	0.05	4.4
Zaporosh'ye	0.08	0.04	0.3	1.4	1.5	1.2	1.2	1.2	0.8	0.4	0.2	0.04	8.4
Khar'kov	0.0	0.0	0.0	0.3	0.2	0.3	0.2	0.2	0.0	0.0	0.0	0.0	1.2
Lugansk	0.0	0.04	0.1	0.8	0.9	1.0	1.3	1.5	1.2	0.4	0.08	0.0	7.3

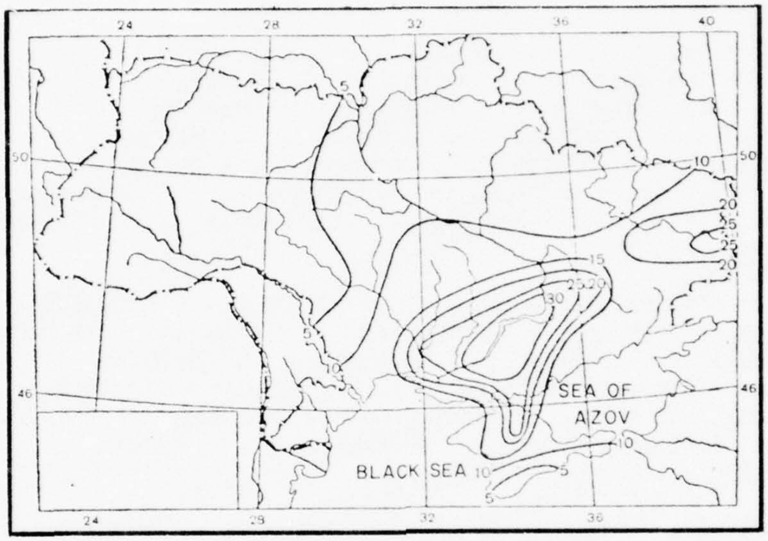

Figure 2. Maximum number of days with dust storms.

TABLE 2

PROBABILITY OF THE OCCURRENCE OF DUST STORMS
AT VARIOUS TIMES OF THE DAY (%)

Stations	Hours of the Day								
	0-4	4-8	8-10	10-12	12-14	14-16	16-18	18-20	20-24
Kamenets-Podol'skiy	0	0	0	7	20	40	20	13	0
Kiev	0	2	2	9	16	25	22	20	4
Chernigov	0	2	10	16	22	28	10	10	2
Voznesensk	1	4	7	24	24	23	14	3	0
Kirovograd	0	5	14	23	19	20	13	5	1
Kherson	0	10	18	25	24	11	7	4	1
Berislav	2	4	12	25	19	17	16	5	0
Verkhnedneprovsk	0	5	18	29	20	14	10	3	1
Novo-Alekseyevka	0	7	15	34	15	15	12	2	0
Gulyaypole	0	6	29	30	13	11	9	2	0
Lugansk	2	4	13	29	16	16	10	9	1

Table 2 shows the daily rate of dust storms for various regions of the Republic. In the majority of places, the daily rate can be quite definitely expressed. Sharp rises in the daily rate are observed only in places where the number of dust storms for the reviewed period was small. It is characteristic that in many places dust storms at night and the early morning hours are rare. After sunrise, the number of cases of this phenomenon increases, attaining the maximum approximately in the middle of the day, then slowly decreasing.

In the south and southwest, the maximum is 10-12 hours (25-35%) and in the north, northwest and west, it approaches 14-16 hours (in up to 40% of the cases). The recurrence of dust storms is approximately parallel to the known daily rate of the wind with a maximum when there is the greatest amount of convection and turbulent vortices. In this way, in the daytime, conditions are more favorable for raising and carrying of dust than at night.

The duration of a dust storm fluctuates very widely, from a quarter of an hour to several days. Storms in the steppe, especially towards the east, are longer. Here, on an average, they last 3-5 hours, and in the Donets Basin Region, up to 8-9 hours.

In the forest-steppe, their average duration is less, approximately 3 hours. In forest areas, only 1 hour. The probability of dust storms of different duration is shown in Table 3.

As was indicated above, very long dust storms occurred in 1960. A prolonged storm was also observed in the south of the Republic in 1946. It lasted from 5 to 8 March. In Donetsk, it lasted 93 hours; in Gulyaypole, 82 hours; in Kramatorsk, 74 hours; and in Krivoy Rog, 63 hours.

It is characteristic that where dust storms are observed more often, they are more prolonged.

In the majority of cases, the soil is dry when dust storms occur; occurrence of a dust storm in a place where the soil is not dry means that the dust was brought from a neighboring territory.

Dust storms are observed mostly on rainless days or on days when the amount of precipitation is small (1-2 mm). In summer months, the total precipitation up to 4 mm and even above does not rule out the possibility of a dust storm.

This normally happens when there is a clear sky and when the clouds are of various shapes.

But, as a rule, especially in summer, the development of dust storms occurs more often when there is a clear sky with a high temperature (up to 30 degrees C and above) and low relative humidity.

TABLE 3

PROBABILITY OF DUST STORMS
OF VARIOUS DURATIONS (%)

Stations	Duration of Dust Storm (hours)					
	<1	1-5	5-10	10-15	15-20	>20
Kamenets-Podol'skiy	100					
Vinnitsa	72	17	6			5
Razdel'naya	47	36	12	1	1	3
Kiev	82	16	2			
Kirovograd	44	34	18	3	1	0
Kherson	23	47	23	6	1	0
Novo-Alekseyevka	24	44	20	8	1	3
Nikopol'	33	48	15	2	1	1
Dnepropetrovsk	31	47	20	2		
Khar'kov	63	19	12	6		
Volnovakha	16	36	42	6		
Lugansk	30	42	23	2	2	1

In up to 40% of the occurrences, dust storms are accompanied by a relative humidity of 25-30%; in 25% of the cases, with a humidity of 21-25%. In 10% of the cases at individual stations, on these days humidity was very low, 11-15%.

During such storms, wind can be from any direction, but the prevailing wind in southern, eastern, and central regions is normally from the east and in northern and northwestern regions, south and southeasterly.

The windspeeds can be quite different. The greatest recurrence (40% of all cases) are dust storms with a speed of approximately 10 m/sec. Dust storms with other windspeeds (up to 20%) can be observed with approximately the same probability. Cases have been recorded when there are significant windspeeds, greater than 15 m/sec (up to 10%); these speeds are most often observed during dust storms on high ground in Priazovsk and on the Donetsk Ridge.

Hence, during one dust storm, lasting from 28 to 31 March 1949, wind with a speed of 15-20 m/sec and above raged for 3 days. Wind of this strength caused greater erosion and crop destruction. In the Priazovsk Region, drifts near obstacles reached 2 m, and protective afforestation strips in some places were so covered by drifts that one could see only the tops of the trees. This dust storm blew away winter and spring crops over an area of 150,778 hectares.

Hence, dust storms (or black storms) occur as a result of the increase in baric gradients, which cause the wind to increase to significant speeds when there is a dry topsoil layer due to lack of rain and a snowless winter.

Baric gradients increase when there are suitable synoptic processes. Dust storms occur most often when there is a stationary anticyclone situated to the east of the Ukraine and there is a cyclone in the west or southwest of Europe. When the trough of low pressure of this cyclone shifts toward the Ukraine, large baric gradients form over this territory. In other cases, cyclonic activity prevails over the north and the northeast of Europe, and a belt of low pressure is situated over the European territory of the Soviet Union. At the same time, the whole central part of Europe is covered by high pressure. Baric gradients increase because of the deepening of the slow-moving Black Sea depression. When this occurs, the anticyclone does not significantly change its position or intensity.

In addition to the synoptic processes, the orography of the region investigated, the character of the soil, the amount of woods, and other local features have a great influence on the onset, recurrence, and intensity of dust storms.

The territory of the Ukraine can be divided into two sections for characterizing the distribution and recurrence of dust storms: the northwest and southeast. The line which divides them almost coincides with the northern boundary of the steppe. The northwest part is noted for the small number of days with dust storms of insignificant duration. The southeastern part is characterized by an increase in the number of days with dust storms having a longer duration. Two sources stand out quite clearly: one with its center in the Kherson-Kakhovka Region, the second in the Lugansk Region.

Besides dust storms which envelop large areas, a considerable number of transitory ones are also observed.

The planting of forests is very effective against dust storms, for they create a mechanical barrier against the wind. Strips of forest considerably reduce the harmful effects of a strong wind both on the soil and on plants [14, 15, 17, 18, 21, 27-29, 33, 34].

Maintaining the lumpy structure of the soil is also important, especially on the tops of hills where the strongest winds occur. Complex and comprehensive studies of this phenomenon must be made by agronomists, soil scientists, meteorologists, and other specialists to successfully solve the problem of the battle against dust storms.

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Dust storms have been the subject of a number of investigations [1, 2, 5-8, and 12-14]. These studies are either descriptions of individual cases [4, 9-11, and 16] or generalized climatic, meteorological or synoptic characterizations of dust storms in the Ukraine. However, winter dust storms have received almost no attention, even though the damage due to them is considerable, especially in agriculture.

A. A. Bychikhin [3] notes the blowing of soils in the southern Ukraine, especially in the former Berdyansk region (Zaporozh'ye region), which occurred in 1848, 1876/77, 1885/86, 1890/91, and according to the data of S. G. Popruzhenko [11], in 1892/93.

In the winter of 1848, strong east winds were blowing for 20 consecutive days, tearing off and shifting snow and ground. The most violent snow storm occurred in the winter of 1876/77 and caused tremendous damage in the fields. However, in areas where the soil was deposited in a flat layer (thickness up to 35 cm), orchards and vineyards were planted on them for the first time. The black soil wind deposits were rated highly by local horticulturists since they contained more humus than the lean soil layer.

The 1885/86 dust storm continued from January to mid-February with strong north and northeast winds, whose force was sometimes that of a hurricane. In particular, the Berdyansk region was heavily damaged by this storm. The blowing of the soil and the deposited dust led to economic impoverishment. The dust storm was so strong that in many fields the soil was shifted to a depth of 25 cm. Plants were uprooted together with the soil. Ravines, gorges, riverbeds and settlements were covered by the dust. The thickness of the deposit was 15-20 cm. In some areas the deposits took on the form of dunes whose height was 1 m. Thirty-four thousand tithes (37,145 ha) of winter crops were destroyed during this time. More than 1,600 agricultural settlements, especially in the southwest part of the region, were covered with soil as a result of the dust storm. The uprooted peasant families went to the city, leaving their houses and farms.

In the winter of 1890/91, a strong northeast wind accompanied by storms blew off the snow and soil in some areas and piled up snowdrifts mixed with soil in other areas. Small obstacles caused the formation of 1.5-2.0 m high snow-soil dunes which were transverse to the direction of the wind and arranged in series at some distance from each other. Gorges

Dzhambul Regions as a Manifestation of Soil Deflation," present collection.

and other depressions in the relief were filled with snow-soil deposits. The winter crop shoots were only retained in spots where they were buried under a thin soil deposit. In areas with considerable blowing of the soil, there were no shoots or they were infrequently noticed.

The 1946, 1951, 1956 dust storms and, especially, the winter 1969 dust storm caused great damage to the economy. The damages caused by dust storms in February 1969 covered nearly the entire territory in which they occurred. In the Zaporozh'ye region and also in individual areas in the Kherson, Dnepropetrovsk, Donets regions and in the south Kharkov region, heavy damage was caused to winter crop seeds, and the top soil layer was eroded to the tillering node. Deposits and mechanical damage to leaves were also observed. In Voroshilovgrad, the top soil layer was shifted to a depth of 4-6 cm and in spots, in plow-fields to a depth of 10 cm.

In the Zaporozh'ye and Donets regions, the speed of the wind during snow storms was as high as 40 m/sec and visibility deteriorated to 50-100 m. The roofs of residential houses and agricultural buildings were torn off and overhead communication and power lines were torn down. In individual areas, pipelines were frozen at low temperatures due to the unavailability of power, and construction organizations and youth establishments interrupted their work.

The strong wind and poor visibility disrupted transportation and, in a number of areas, roads, buildings and engineering structures were buried under the deposits. Thus, in Lozovaya, the dust deposit on flat sectors was 1-2 cm, on slopes 3-5 cm, and in gorges 30-60 cm. The snow drift mixed with the dust was 4 m high in gorges near forests. The amount of precipitated dust in Bobrinets, Dolinskaya (Kirovograd region) was from 300 to 750 g/m^2 and in Volnovakha (Donets region), about 1800 g/m^2.

Everything mentioned above sufficiently indicates the need for a deeper study of the phenomenon described.

Presented below are the average number of days (over many years) with a dust storm in various regions in the Ukraine and their calculated probability of occurrence. Also, it is pointed out how the number of days and the duration of the snow storm depend on the velocity of the wind. The territories covered and the meteorological conditions accompanying the winter snow storms are also considered and the synoptic situation is analyzed.

The listed problems were studied using the data obtained from observations of 185 meteorological stations in the Ukraine between 1936 and 1969. The results obtained from an analysis of the data for the period mentioned have shown that dust storms occur only in the eastern half of the Ukraine (Fig. 1).

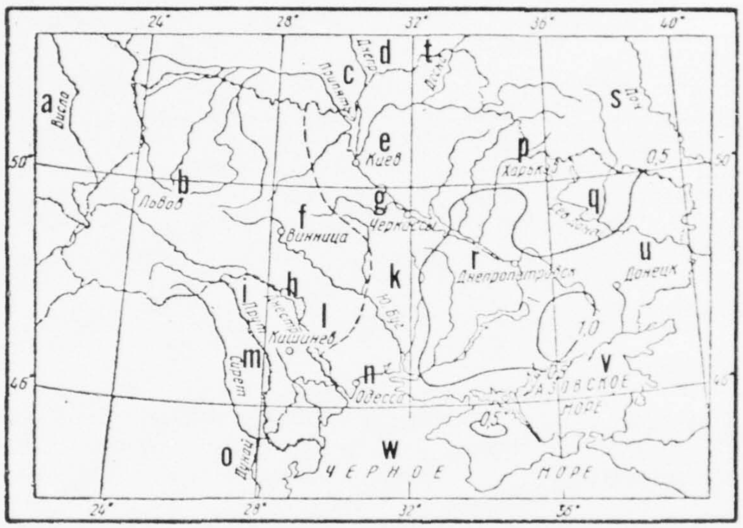

Figure 1. Number of days with snow storms. December-February.

Key:			
a.	Wisla	m.	Siret
b.	L'vov	n.	Odessa
c.	Pripyat'	o.	Danube
d.	Dnepr	p.	Khar'kov
e.	Kiev	q.	North Donets
f.	Vinnitsa	r.	Dnepropetrovsk
g.	Cherkassy	s.	Don
h.	Dnestr	t.	Desna
i.	Prut	u.	Donetsk
k.	South Bug	v.	Sea of Azov
l.	Kishinev	w.	Black Sea

The boundary, west of which the winter dust storms do not spread is indicated on the map by the dashed line.

In the southeast direction, the frequency with which the phenomenon is repeated increases considerably. Dust storms occur most frequently nearly every winter on the territory of the Zaporozh'ye region (Berdyansk-Botevo-Melitopol'-Kirillovka-Gulyay Pole). Here, in 50 percent of the winters, there is no solid snow cover and the largest number of days (15-20 per winter) with a strong wind ($\geq$ 15 m/sec) is observed.

The average number of days with a dust storm over the 34 years considered is given in Table 1. A considerable difference in the frequency of occurrence of storms throughout the winter season is evident from the table.

Dust storms are extremely rare in December - altogether 1-2 days per decade (only in the southeast Ukraine), and in the remaining regions 3-8 days per 100 years.

In January dust storms were observed more frequently and over a larger territory: in the Priazovskaya Vozvyshennost' region, in the Crimean steppe, on the average, 2-3 days in 10 years, and in the remaining territory 1 day in 10 years.

In February dust storms encompass an even larger territory and the average number of days with a storm increases to 5-7 days over a sizable portion of the southeast and up to 1-4 days over the remaining territory. The maximum number of days with a dust storm per winter (Table 1) varies from 5 in the northwestern Ukraine to 20-23 in the southeastern Ukraine.

In the 34 years studied, 20 winters were accompanied by dust storms (1937-1939, 1943, 1944, 1946, 1948-1951, 1953-1956, 1958-1960, 1962, 1964, 1965, and 1969). However, in the majority of cases, they were only noted at individual stations in 1946, 1951, 1956, and 1969, while the dust storms also encompassed large areas in many southern and southeastern regions in the Ukraine and caused considerable damage to the economy.

Table 2 gives the probability for different numbers of days with a dust storm. Certain characteristic features can be detected when these data are studied. Thus, for example, for a large part of the territory, the probability of 1-5 days with a dust storm per winter is 3-10 percent of all observed years and the probability of 6-10 days is 3-5 percent. In the southeast of the republic (Voroshilovgrad, Donetsk, Zaporozh'ye, Kherson, and Dnepropetrovsk regions), the number of days with a dust storm increases. Here 10-20 days with a dust storm can occur with a probability of 3-5 percent.

TABLE 1

NUMBER OF DAYS WITH DUST STORM

Station	December		January		February		December-February	
	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
				CHERNIGOV REGION				
Sechenovka	0.03	1	-	-	-	-	0.03	1
Chernigov	0.03	1	0.03	1	-	-	0.06	1
Priluki	0.04	1	-	-	0.2	5	0.02	5
				SUMY REGION				
Sumy	-	-	-	-	0.2	6	0.2	2
				KIEV REGION				
Chernobyl'	0.07	2	-	-	0.07	2	0.1	2
Kiev	-	-	-	-	0.1	3	0.1	3
Belaya Tserkov	-	-	-	-	0.09	3	0.09	3
				POLTAVA REGION				
Gadyach	-	-	-	-	0.3	9	0.3	9
Poltava	-	-	-	-	0.5	14	0.5	14
				KHAR'KOV REGION				
Khar'kov	-	-	0.08	2	0.6	16	0.7	18
Lozovaya	-	-	-	-	0.4	12	0.4	12
				CHERKASSY REGION				
Zolotonosha	-	-	0.03	1	0.2	5	0.2	2
				VOROSHILOVGRAD REGION				
Svatovo	-	-	-	-	0.5	14	0.5	14
Belovodsk	-	-	0.1	3	0.6	16	0.7	19
Voroshilovgrad	-	-	0.03	1	0.5	15	0.5	16

Table 1 (cont)

Station	December		January		February		December-February	
	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
KIROVOGRAD REGION								
Kirovograd	0.06	2	0.06	2	0.4	9	0.5	11
DNEPROPETROVSK REGION								
Dnepropetrovsk	0.04	1	0.1	3	0.5	16	0.6	19
Sinel'nikovo	0.1	2	0.09	3	0.5	14	0.7	17
Krivoy Rog	0.07	1	0.1	3	0.5	13	0.7	16
DONETSK REGION								
Artemovsk	-	-	0.04	1	0.7	17	0.7	18
Krasnoarmeyskoye	-	-	0.09	2	0.7	15	0.8	17
Donetsk	0.1	2	0.2	3	0.5	9	0.8	12
Amvrosiyevka	0.03	1	0.1	2	0.6	15	0.7	17
ODESSA REGION								
Odessa	-	-	0.1	3	0.2	6	0.3	9
Bolgrad	-	-	0.04	1	0.2	3	0.2	3
Izmail	0.04	1	0.04	1	-	-	0.08	1
ZAPOROZH'YE REGION								
Zaporozh'ye	0.03	1	0.2	3	0.5	16	0.7	19
Gulyay Pole	0.2	3	0.2	3	0.7	15	1.1	18
Kirillovka	0.2	4	0.3	7	0.6	16	1.1	23
Botevo	0.1	2	0.3	5	1.0	15	1.4	20
NIKOLAYEV REGION								
Voznesensk	0.03	1	0.09	3	0.2	4	0.3	7
KHERSON REGION								
Bol'shaya Aleksandrovka	-	-	0.09	2	0.4	9	0.5	11
Nizhniye Serogozy	0.1	3	0.1	3	0.5	11	0.7	14

Table 1 (cont)

Station	December		January		February		December-February	
	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
KHEROSON OBLAST' (cont)								
Novaya Kakhovka (Berislav)	0.08	2	0.2	4	0.5	10	0.8	14
Kherson	0.08	2	0.1	4	0.4	10	0.6	14
Popelak	-	-	0.1	4	0.3	8	0.4	12
Bekhtery	0.03	1	0.06	2	0.1	5	0.2	7
CRIMEAN REGION								
Dzhankoy	-	-	0.2	3	0.2	3	0.4	6
Klepinino	-	-	0.2	5	0.5	10	0.7	15
Belogorsk	-	-	0.06	2	0.06	2	0.1	2

TABLE 2

PROBABILITY (%) OF DIFFERENT NUMBER OF DAYS WITH DUST STORM IN INDIVIDUAL YEARS

Number of Days with Dust Storm	Dec	Jan	Feb	Dec-Feb
	CHERNIGOV REGION Priluki			
0	96	100	97	94
1-5	4		3	6
	KIEV REGION Belaya Tserkov'			
0	100	100	97	97
1-5			3	3
	POLTAVA REGION Gadyach			
0	100	100	97	97
1-5				
6-10			3	3
11-15				
	Poltava			
0	100	100	97	97
1-5				
6-10				
11-15			3	3

Table 2 (cont)

Number of Days with Dust Storm	Dec	Jan	Feb	Dec-Feb
	KHAR'KOV REGION Khar'kov			
0	100	96	96	96
1-5		4		
6-10				
11-15				
16-20			4	4
	CHERKASSY REGION Zolotonosha			
0	100	96	94	91
1-5		4	6	9
	VOROSHILOVGRAD REGION Svatovo			
0	100	100	97	97
1-5				
6-10				
11-15			3	3
16-20				
	Belovodsk			
0	100	97	97	96
1-5		3		
6-10				
11-15				
16-20			3	4
	Voroshilovgrad			
0	100	97	94	94
1-5		3	3	3
6-10				
11-15			3	
16-20				3

Table 2 (cont)

Number of Days with Dust Storm	Dec	Jan	Feb	Dec-Feb
	KIROVOGRAD REGION Kirovograd			
0	97	97	91	88
1-5	3	3	6	9
6-10			3	
11-15				3
	DNEPROPETROVSK REGION Dnepropetrovsk			
0	93	97	97	94
1-5	7	3		3
6-10				
11-15				
16-20			3	3
	Sinel'nikovo			
0	97	97	94	88
1-5	3	3	3	9
6-10				
11-15			3	
16-20				3
	Krivoy Rog			
0	93	96	94	87
1-5	7	4	3	10
6-10				
11-15			3	
16-20				3

Table 2 (cont)

Number of Days with Dust Storm	Dec	Jan	Feb	Dec-Feb
		DONETSK REGION Artemovsk		
0	100	96	92	92
1-5		4	4	4
6-10				
11-15				
16-20			4	4
		Krasnoarmeyskoye		
0	100	96	92	92
1-5		4	4	4
6-10				
11-15			4	
16-20				4
		Donetsk		
0	92	92	92	84
1-5	8	8	4	12
6-10			4	
11-15				4
		Amvrosiyevka		
0	97	94	94	94
1-5	3	6	3	
6-10				3
11-15			3	
16-20				3
		ODESSA REGION Odessa		
0	100	97	93	94
1-5		3	4	3
6-10			3	3

Table 2 (cont)

Number of Days with Dust Storm	Dec	Jan	Feb	Dec-Feb
		Bolgrad		
0	100	96	92	92
1-5		4	8	8
		Izmail		
0	96	96	100	92
1-5	4	4		8
		ZAPOROZH'YE REGION **Zaporozh'ye**		
0	97	94	94	87
1-5	3	6	3	10
6-10				
11-15				
16-20			3	3
		Gulyay Pole		
0	94	94	91	85
1-5	6	6	6	9
6-10				3
11-15			3	
16-20				3
		Kirillovka		
0	94	94	91	87
1-5	6	3	6	9
6-10		3		
11-15				
16-20			3	
21-25				4

Table 2 (cont)

Number of Days with Dust Storm	Dec	Jan	Feb	Dec-Feb
	Botevo			
0	91	86	86	66
1-5	9	14	10	29
6-10				
11-15			4	
16-20				5
	NIKOLAYEV REGION Voznesensk			
0	97	97	97	91
1-5	4	3	3	6
6-10				3
11-15				
	KHERSON REGION Bol'shaya Aleksandrovka			
0	100	96	96	96
1-5		4		
6-10			4	
11-15				4
	Nizhniye Serogozy			
0	96	96	92	88
1-5	4	4	4	8
6-10				
11-15			4	4
	Novaya Kakhovka (Berislav)			
0	96	96	88	84
1-5	4	4	8	12
6-10			4	
11-15				4

Table 2 (cont)

Number of Days with Dust Storm	Dec	Jan	Feb	Dec-Feb
		Kherson		
0	96	97	97	92
1-5	4	3		4
6-10			3	
11-15				4
		Bekhtery		
0	97	97	97	94
1-5	3	3	3	3
6-10				3
		CRIMEAN REGION Dzhankoy		
0	100	92	92	88
1-5		8	8	8
6-10				4
11-15				
		Klepinino		
0	100	94	84	81
1-5		6	13	16
6-10			3	
11-15				3
		Belogorsk		
0	100	97	97	93
1-5		3	3	7

The meteorological conditions during the intense dust storm period are illustrated in Table 3. It follows from Table 3 that for storms causing blowing of soils, uprooting of plants and other damages, the following specific features are most characteristic:

Winds from the east and northeast

High wind speed ($\geq$ 15 m/sec)

Moderate relative humidity of the air (below 70 percent)

Poor visibility (50-500 m).

Winter dust storms usually occur when the snow cover is slight or when it is completely absent and when the surface of the soil is slightly moist.

According to the studies by D. P. Ryzhikov [15], the blowing out of soils in the winter (black storms) occurs in years in which the air temperatures are low, in the presence of a slight snow cover, and slightly moist soil in the spring.

According to his observations, the winter dust storms in the Ukraine occur nearly every year on sandy-loam soils, somewhat less frequently on dark-chestnut soils, and very rarely (at most once per 10 years) in the northern part of the steppe in the ordinary soil zone.

The dust storms in the cold season of the year are characterized by considerably longer duration compared to dust storms in the warm season. Winter dust storms are observed during easterly winds, whereas during the warm season of the year, they can also occur in other directions. In the majority of cases (more than 50 percent) the dust storms begin at 10-14 hr and only in isolated cases do they begin at night.

Certain relationships have been established for night storms causing considerable damage. A direct correlation exists between the number of days with a dust storm and the number of days with a strong wind. The correlation coefficient between these quantities when the windspeed is $\geq$ 15 m/sec is 0.64 (Fig. 2a).

It follows from the graph presented in Figure 2a that approximately 60 percent of the dust storms occur when the windspeed is $\geq$ 15 m/sec. Generally, the windspeeds during dust storms vary within a wide range. The minimum speed noted in winter during a dust storm was 6 m/sec and the maximum speed was 40 m/sec.

TABLE 3

METEOROLOGICAL CONDITIONS DURING DUST STORMS

Year	Month	Number of Days with Dust Storm	Total Duration of Dust Storm (hr)	Direction of Wind	Windspeed (m/sec)	Air Temperature (deg C)	Relative Humidity (%)	Visibility (m)
1946	December	1-4	25-55	East, northeast	16-20, gusts up to 30	-6, -14	40-48	100
1950-1951	February	1-4	1-33	East, northeast	17-20	-10	50-70	200-500
1956	February	1-4	3-8	East, northeast	16-34	-5, -14	40-70	200-400
1969	January	4-7	20-100	East	28-40	-3, -10	30-50	200-500
	February	2-17	8-275	East	28-40	-4, -10	50-70	50-100

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BOUNDARY LAYER DUST OCCURRENCE, III, ATMOSPHERIC DUST OVER RUSS--ETC(U)
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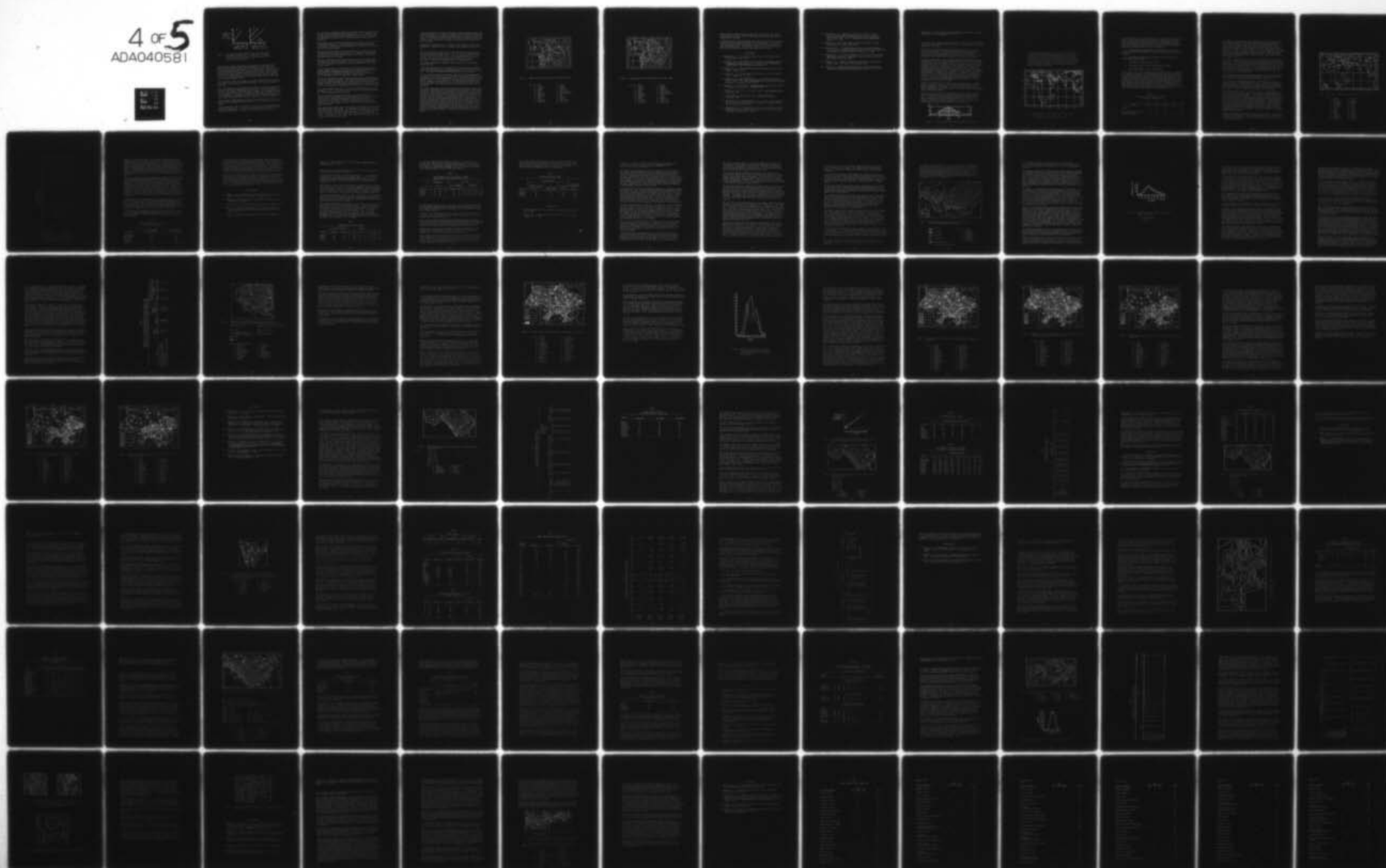

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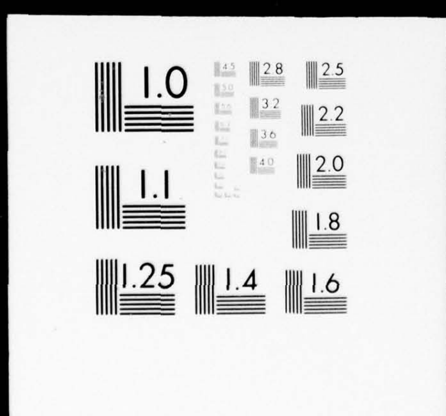

MICROCOPY RESOLUTION TEST CHART
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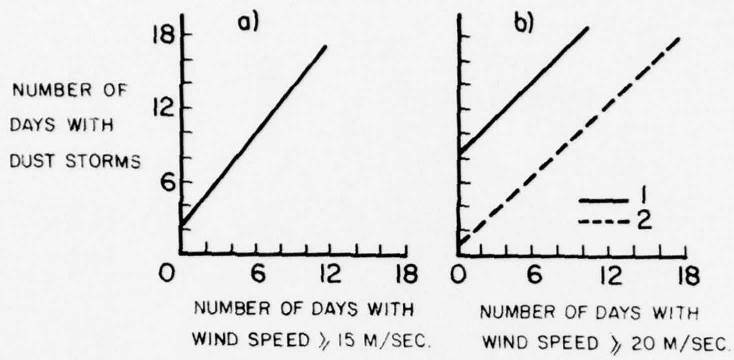

Figure 2. Correlation between number of days with dust storms and number of days with: (a) wind speed ≥ 15 m/sec and (b) ≥ 20 m/sec based on current observations (1) and with gale forecast (2).

Approximately the same correlation exists between the duration of the storms and the number of days with a windspeed ≥ 20 m/sec (Fig. 2b). The wind regime during dust storms can be characterized in greater detail by gale forecast data since they give strong gusts. The correlation coefficient between the number of days with a dust storm and the number of days with a strong wind (≥ 20 m/sec) based on gale forecast data was 0.75, i.e., in the majority of cases dust storms were noted on days when the windspeed exceeded 20 m/sec.

The correlation coefficient between the maximum windspeed during the dust storm and its duration per hour was calculated. For the winter season it was 0.68.

Thus, the possibility of determining the duration of the dust storm on the basis of the maximum windspeed has been outlined. When the windspeed is 15 m/sec, the duration of the dust storm is about 15 hr, and when the windspeed increases to 20 m/sec, the duration of the storm increases to 25 hr, etc. Apparently, the accuracy of these data can be further increased by taking into account additional factors (state of the ground surface, etc.).

The intensity of dust storms can also be inferred on the basis of the amount of dust transferred by the airflow, i.e., on the basis of the visibility.

Studies have shown that in 90 percent of the cases when the windspeed per observation period was ≥ 15 m/sec, the visibility was less than 1 km and when the windspeed was ≥ 20 m/sec, the visibility was 500 m or less.

The correlation coefficient between the windspeed and the visibility during dust storms was negative and it was equal to -0.73. However, cases can occur when an increase in the windspeed to 10-12 m/sec or even less (in the presence of dry soil) will cause considerable deterioration in visibility.

The dimensions of the territory encompassed by the dust storms are of considerable importance. The 1969 winter storms exceed all previous storms noted in the Ukraine in this century by area distribution and also by their force and duration.

When the dust storms began, there was practically no snow cover in the southern Ukraine and the soil was frozen. An increase in the easterly wind speed to 28-35 m/sec, and occasionally to 40 m/sec, caused frost eolation of the top soil layer.

The January 1969 dust storms covered the territory of the Zaporozh'ye, Dnepropetrovsk, Donetsk, Nikolayev, Kherson, Kirovograd, Crimean and partially Voroshilovgrad regions and also the southern portion of the Poltava region.

The dust storm began on 4 January 1969 in the Zaporozh'ye and in the western Donetsk region and it covered a territory of about 40,000 km^2. Within one day it propagated over the entire southern half of Levoberezh'e and a portion of Pravoberezh'e, an area of 250,000 km^2 and it remained in this territory until 8 January 1969.

Due to the predominantly easterly wind, the dust storms propagated primarily in a westerly direction. The speed of movement in this direction was greater than 300 km/day, and in a northerly direction about 100 km/day. The main dust storm centers lasting from 4 to 7 days, were noted in the central regions of the Zaporozh'ye, Kherson, and Crimean regions.

Their total duration was 20-60 hr, and in the Zaporozh'ye region it was as long as 100 hr. It did not exceed 10 hr only in isolated portions of the Poltava and Voroshilovgrad regions.

After a one month interruption, the dust storms started again in February 1969. They reached their peak development in the periods 9-12, 16-19, and 23-26 February, propagating nearly over the entire Levoberezh'ye, the Crimean, Nikolayev, Dnepropetrovsk, Kirovograd, Cherkassy, and Kiev regions. The total territory covered was greater than 350,000 km^2.

There was nearly no snow cover in the eastern and southern Ukraine before the February dust storms began. In individual spots there was a 2-3 cm thick snow cover. The top soil layer was dried out considerably by the January dust storms (in areas where there were no deposits and snow cover). Therefore, the dust storms were renewed simultaneously with the increase in the force of the wind.

Unlike the January dust storms, the February storms propagated toward the north and northwest. The speed of movement during the first 24 hours was about 300 km/day, and during the subsequent days it decreased to 200-250 km/day. The character of the ground layer and the conditions under which the dust storms were formed in January and February were similar over a large territory.

Altogether, in February, 10 to 17 days with dust storms occurred in the Levoberezh'e steppe zone and 2 to 9 days in the remaining regions (Fig. 3).

The total duration of these storms in the Zaporozh'ye, Voroshilovgrad, and Poltava regions exceeded 200 hr (Fig. 4). Over the remaining territory it varied from 50 to 200 hr. The maximum duration of one dust storm was four days in the Voroshilovgrad, Gulyay Pole, Nikopol', Armtemovsk, Komissarovka, Dnepropetrovsk, and Kharkov areas.

The weather conditions in February 1969 during the dust storms were highly variable.

During the first period (8-12 February 1969), anticyclones and weather without precipitation with air temperatures from -14 to -20° C were dominant. The relative humidity fluctuated between 50 to 90 percent.

In the subsequent periods, during which the dust storms developed due to an increase in cyclonic activity over western Europe and the Black Sea, snowfalls and snow storms accompanied by dust storms were observed in the eastern Ukraine. In the snow drifts, the snow was mixed with dust and the air temperature increased to -4, -10°C and higher; however, it remained negative. The relative humidity also increased to 70-90 percent and above.

The synoptic conditions under which the January and February storms originated were characterized by the stability of the processes and by marked similarity. Quasistationary anticyclones with a pressure at the center exceeding 1040 mb, moving from the north or northeast occurred above the central or eastern portions of the European territory of the USSR. Above the Black Sea, a slowly moving depression occurred. High barometric pressure gradients (4-7 mb/100 km and higher) were formed under this distribution of barometric pressure centers above the southern and southeastern Ukraine, increasing the force of the east and southeast wind. A stable wind in these directions was observed up to an altitude of 16 km and the dust particles were raised to an altitude of 2 km. Very large masses of dust were carried by this wind over great distances in the western and east-west direction. Settling of the dust was noted even in Sweden.

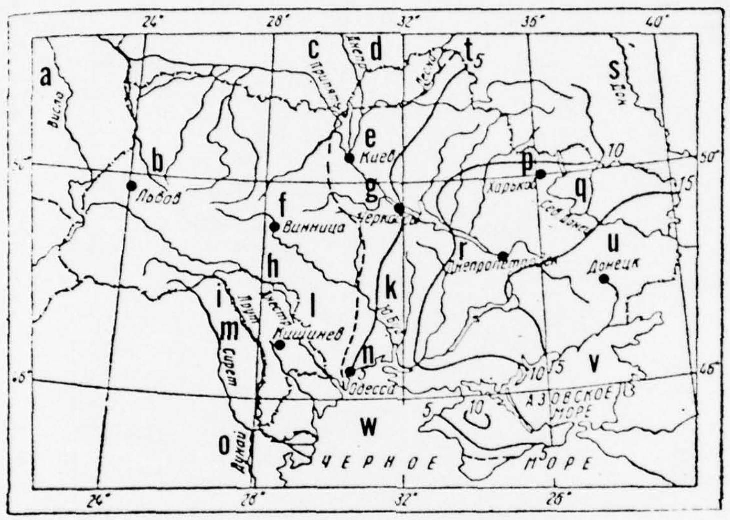

Figure 3. Number of days with dust storms in February 1969.

Key:
a. Wisla
b. L'vov
c. Pripyat'
d. Dnepr
e. Kiev
f. Vinnitsa
g. Cherkassy
h. Dnestr
i. Prut
k. South Bug
l. Kishinev
m. Siret
n. Odessa
o. Danube
p. Khar'kov
q. North Donets
r. Dnepropetrovsk
s. Don
t. Desna
u. Donetsk
v. Sea of Azov
w. Black Sea

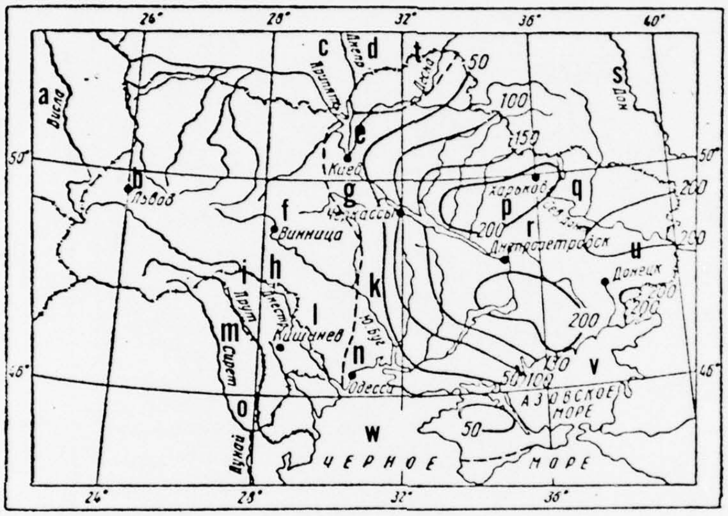

Figure 4. Total duration (hr) of dust storms in January 1969.

Key:

a. Wisla	m. Siret
b. L'vov	n. Odessa
c. Pripyat'	o. Danube
d. Dnepr	p. Khar'kov
e. Kiev	q. North Donets
f. Vinnitsa	r. Dnepropetrovsk
g. Cherkassy	s. Don
h. Dnestr	t. Desna
i. Prut	u. Donetsk
k. South Bug	v. Sea of Azov
l. Kishinev	w. Black Sea

Mention should be made of the fact that during the intense dust storms studied earlier in 1946, 1951, and 1956, approximately the same synoptic processes were observed.

In almost all cases the anticyclones moved from the northeast or east and stabilized above the eastern regions of the European USSR. The pressure in anticyclones was 1050 mb and higher. Cyclone activity was observed above the southern seas. The synoptic processes in 1946, 1951, and 1956 were of shorter duration and less stable than those in 1969.

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Dust storms are a frequent phenomenon in deserts and semiarid lands; they also occur over steppe areas in a dry period. Sand storms are a particular instance of dust storms.

Dust storms are produced by winds with speeds in excess of 8 m/sec. A mass of sand and dust is raised from the surface of the earth, which sometimes causes such significant atmospheric turbidity that it is impossible to distinguish objects at a distance of a few meters. During a dust storm, the horizontal visibility is usually not over 1000 m.

The dust raised during a storm, in the form of yellow or reddish clouds (depending on the color of the suspended particles), spreads to altitudes of about 500 m; but, in individual cases, it can reach 3-5 km. After the end of a dust storm, the particles of dust involved in the storm remain suspended in the air, in the form of a fine powder, which reduces visibility to 10-15 km and, in individual cases, to 3-4 km. However, the greatest quantity of particles is transported in the layer of air adjacent to the ground. According to the data of P. S. Zakharov [1], in Central Asia, 70% of the dust and sand raised from the earth is transported at heights of up to 5 cm above the surface of the ground at a windspeed of 11 m/sec); i.e., it is as though the particles of sand were drifting. It is no accident that a desert landscape with sand dunes is similar in appearance to a sea frozen in midwave.

Usually, the length of a storm varies from a few minutes to 1-2 hours, but dust storms can sometimes last 2-3 days and more without a break, during a prolonged, strong wind. The most favorable time of day for their development is the daytime hours, i.e., the time when the windspeed reaches the highest values.

The daily course of dust storm frequency in the Lake Chad area during the dry season, taken from the work of Ekhart [4], is reproduced in Fig. 1. The figure shows that about 4/5 of the total number of dust storms recorded occur during daylight, from 6 a.m. to 6 p.m. The greatest probability of their development is at noon. The same daily distribution is observed in the deserts of the USSR [3].

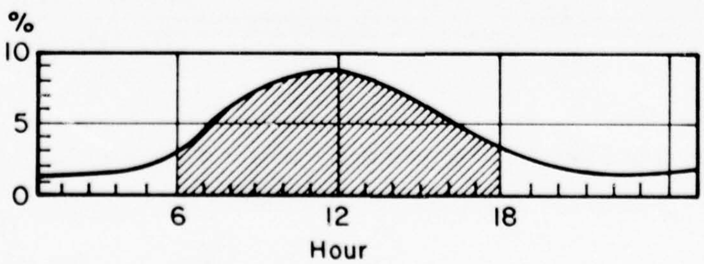

Figure 1. Daily course of dust storm frequency at Lake Chad.

With observational data available on the number of days with dust storms at stations in the tropical belts of Asia and Africa, a map of the distribution of their mean annual number was produced (Fig. 2). The figure shows that dust storms are observed predominantly in the desert and semiarid climate zone. This zone is distinguished by dashed lines on the map. In the zones adjacent to it, the subtropical climate and the humid tropical climate, there are no dust storms as a rule, and the passage of dust clouds is possible only over limited areas. With involvement of dust in the circulation of large-scale air masses, dust particles may be transported to distances of thousands of kilometers.

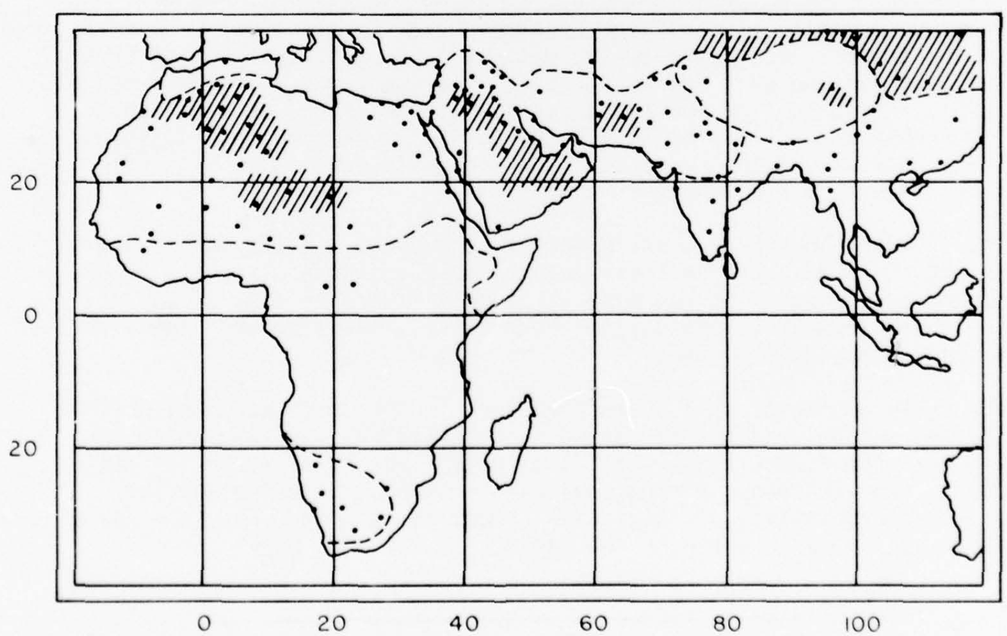

Figure 2. Mean annual number of days with dust storms: Africa and Asia.
//// over 20.
---- boundary of desert and semiarid climate zone.

The largest number of days with dust storms is noted in the driest desert regions of the tropical belt with tradewind circulation, where strong winds caused by the passage of fronts are noted frequently. Regions where dust storms are recorded on more than 20 days per year are distinguished on the map by cross hatching. As a rule, these are the inner areas of the largest deserts of the world, namely,

a. The northern and central part of the Sahara, characterized by the maximum number of dust storms at the Ain Salak (48) and Largeau (48) stations;

b. The deserts of the Arabian peninsula, with the Badanah (41) and the Riyadh (54) stations;

c. Tar desert, Dalbandin station (29);

d. Gobi desert, Ansi (120) and Lanchow (46) stations;

e. Takla Makan desert, Kashgar station (25).

From the point of view of development of dust storms, there is considerable interest in Australia, the underlying surface of the soil of which is predominantly desert. Loewe [5] indicates that dust storms are noted in almost the entire territory of Australia, with the exception of its southwest extremity and the Arnhem Land and Cape York peninsulas located in the north. The province of Mallee, in the northern part of New South Wales (approximately at the intersection of 30° S latitude and 140° E longitude) is subjected to dust storms most often. The mean number of days with dust storms, obtained from the combined data of several stations and in two districts of the country, are presented in Table 1.

TABLE 1

FREQUENCY OF DAYS WITH DUST STORMS
BY SEASONS: AUSTRALIA

Region	Spring	Summer	Autumn	Winter	Year
Mallee	12	14	8	1	35
Upper and Western Districts of New South Wales	8	9	4	1	22

The number of dust storms over the populated arid regions of the world has increased noticeably in the past decade, because of plowing the virgin lands and unused land. These are the so-called black storms. The increase in storms in the Great Plains of the USA can be cited as an example of the increase of such storms. Here, in three summer seasons (from 1933 to 1935), 22 storms occurred, in place of individual occurrences earlier. As a result, the upper layer of soil was removed from extensive areas, equal to many thousands of square kilometers. Dust storms are increasing in the populated areas of China, India, and Australia because of plowing the land.

Dust storms usually have specific names, depending on the place of their formation: in Algeria, shekheli; Tunisia, chyly; Morocco, shergi; Libya, ghibli; UAR, khamsin; Sahara, dshani; and the Sudan, haboob. The Italian name of dusty, dry winds of the deserts of Africa and Asia, sirocco, is used frequently in the literature. In the coastal deserts of the Persian Gulf regions, red and yellow dust storms are widespread, shamals and, on the southern coast of Arabia, belats. Dry, hot, dusty winds over the Ganges Valley are called munchins.

The distribution of dust storms during the year is usually well-defined, with periods of maximum and minimum development. The map-diagram is an illustration of the annual course of dust storms (Fig. 3).

In an examination of the annual course of dust storms over semiarid lands it should be remembered that the course is determined predominantly by the variation of precipitation, and secondarily and only during the dry period by winds of considerable strength. The annual variation over the deserts is determined only by the distribution of windspeed.

The frequency of dust storms in semiarid regions is represented by the diagrams of the following stations: Fort Lamy and Abeche (Chad), New Delhi (India) and Sichang (China). The graph shows that, with the onset of the rainy season (from May to October in Chad, from June to September in India and from April to October in Southern China), the number of dust storms decreases sharply to total disappearance. With the beginning of the dry season, the storms gradually form again. The mean number of days with dust storms in the hottest months usually is not over four. Thus, the change of seasons, even with relatively low total annual precipitation (200-300 mm), is favorable to recovery of the soil structure and anchoring of the soil by plants. In connection with this, the number of dust storms decreases.

In the desert regions, dust storms are noted every month. Average values obtained from observational data over predominantly recent years (over a period of about 10 years, except for China, where the period is 4 years) are presented in Table 2.

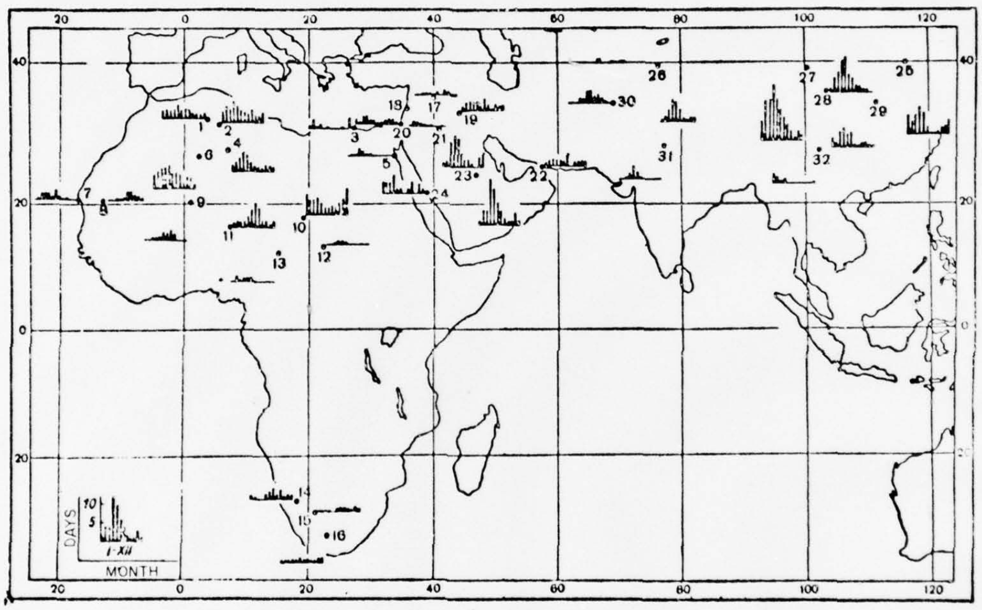

Figure 3. Annual course of number of days with dust storms: Africa and Asia.

Key:

1. Laghouat
2. Ouargla
3. Marsa Matruk
4. Fort Flatters
5. Al Gurdaqah
6. Ain Salak
7. Port Etienne
8. Atar
9. Tessalit
10. Largeau
11. Agades
12. Abeche
13. Fort Lamy
14. Keetmanshoop
15. Upington
16. Beaufort West
17. Deirez Zor
18. Beirut
19. Baghdad
20. Beersheba
21. Badanah
22. Jask
23. Riyadh
24. Jidda
25. Peking
26. Kashgar
27. Changyeh
28. Lanchow
29. Loyang
30. Kabul
31. New Delhi
32. Sichang

TABLE 2

AVERAGE MONTHLY AND ANNUAL NUMBER
OF DAYS WITH DUST STORMS

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Ouargla (Algeria)	3	4	4	6	4	3	3	2	3	1.5	1.5	3	38
Fort Flatters (Algeria)	1.8	3	4	5	5	2	1.0	0.8	0.2	1.5	1.0	0.8	26
Aoulef el Arab (Algeria)	1.2	3	1.7	3	2	4	2	3	1.0	1.2	1.1	0.7	24
Agades (Niger)	1.1	1.4	0.8	1.4	3	5	6	5	1.6	1.5	0.3	2	29
Keetmanshoop (S. W. Africa)	0.8	0.2	0	0	1.2	1.8	3	1.2	2	0.6	1	0.8	13
Zabol (Iran)	0.6	0.6	0.4	0.1	0.1	1.8	2	3	1.4	0.8	0	0.6	11
Jask (Iran)	0.3	1.2	1.7	1.6	1.6	1.3	3	0.1	0.7	0.9	1.3	1.1	15
Al Habbaniya (Iraq)	1.5	1.9	2.0	3	3	1.2	1.9	0.5	0.5	0.7	0.8	0.4	17
Beersheba (Israel)	1.3	0.6	2	2	1.0	1.0	0.1	0.3	0.7	1.1	1.1	0.6	12
Dalbandin (Pakistan)	1.0	2	4	4	4	4	5	2	1.2	0.8	0.3	0.8	29
Ansi (China)	6	11	13	16	15	13	10	10	7	6	7	6	120
Szechwan (China)	1.7	3	7	10	9	7	5	4	2	2	3	3	57

The data in Table 2 show that in the Northern Hemisphere the maximum number of days with dust storms occurs in the summer and the minimum number in the winter. This distribution is explained by the development of cyclonic and turbulent activity above the scorching plains of the desert in the summer and, on the other hand, by weakening of the airflow above the continents during winter due to formation of strong anticyclones. In individual cases, deviations from the time of onset of the extreme values is possible, owing to the development, for example, in winter, of frontal activity near the coast or tradewind circulation above the land.

There is a definite correlation between the frequency of days with dust storms and strong wind, which depends on the structure of the soil surface (a windspeed of over 16 m/sec is accepted as strong in foreign countries). In particular, in the deserts of the Western Sahara, the number of days with dust storms is less than the number of days with a strong wind, since clay, gravel and rocky soils, with a negligible content of transportable particles, predominate here. For example, in Tessalit, 9.7 days with dust storms and 27.5 days with a strong wind are recorded in a year, on the average. Consequently, it can be assumed that in this region, because of the soil structure characteristics, dust storms reach limiting characteristics, only with windspeeds exceeding 16 m/sec.

In the deserts of the Northern and Central Sahara, as well as of Northern China, where the soils are sandy loams and light with admixtures of loess, the number of days with dust storms exceeds the number of days with a strong wind. Thus, for example, at Largeau station, there are 39.6 days per year with dust storms on the average and 24.5 with a strong wind and, at Kashgar station, 24.5 and 15.6 days, respectively.

In the Libyan and Arabian deserts, which are sandy and in places, rocky, the ratio between the phenomena being considered is close to 1. The values by stations of the UAR, presented in Table 3, are an example of their agreement.

TABLE 3

FREQUENCY OF DAYS WITH DUST STORMS
AND STRONG WIND, UAR

Station	No. of Days With Dust Storm	No. of Days With Strong Wind
Sidi Barrani	3.8	3.4
Mersa Matruh	7.0	7.6
Alexandria	1.6	1.3
Siwa	3.2	1.6
Khurgada	5.2	6.8

The number of days with a dust storm in any month considered separately and for the entire year can change significantly from year to year. The calculated root mean deviation, sigma, for July was 2.9 at the Aoulef, 2.4 at the Tessalit and 2.7 days at the Largeau stations, with respect to the mean monthly values of 2.4, 1.8, and 2.1, respectively. The examples presented show that the coefficient of variation, c_v, of the element under consideration reaches 100% and more; i.e., in separate years, its value can differ from the mean value over many years by 2 and even 3 times.

We note that the approach and development of dust storms has an extremely depressing effect on the mood of a person, although these storms are not as dangerous as is customarily considered. Capo-Rey [2], a native of France, in gathering material on the climate of the Sahara and in traveling much over the desert, asserts that dust storms are easy to tolerate and that it is sufficient only to have the patience to wait them out, wrapped up in cloth or sheltered in a tent.

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Dust storms in the Transvolga destroy the soil cover and can damage agricultural crops, especially in spring.

At the All-Union Congress at the Soil Institute im. V. V. Dokuchayev on the problem of soil erosion (12-16 December 1955), it was stated that recently, new centers of wind erosion had occurred as the result of continuous plowing of sandy and sandy-loam soil in arid and semiarid regions [1].

Dust storms occur when there is sufficient windspeed and when a considerable surface of dry soil is not covered by vegetation. Since the composition and structure of the soil is not uniform and the degree of vegetation cover is dissimilar, in various weather conditions, there are often dust storms in some regions, not necessarily embracing the whole Transvolga.

According to observations made for 20 years (1936-1955), in the Transvolga regions of the Saratov district, dust storms were noted yearly; but the number of storms, the intensity, and other meteorological indicators varied considerably from one year to another.

On an average, during the year there were approximately 5-6 days and in dry years up to 13-15 days with dust storms (Table 1). Dust storms were encountered less rarely in spring and autumn than in summer. According to calculations over 20 years, dust storms appeared often in Pugachev in September, apparently because of local features. Data from Yershov and Saratov shows that dust storms did not occur there. In a dry September, there can be many storms throughout the whole Transvolga. According to N. S. Temnikova [2], in the Stalingrad district, the greatest probability for dust storms is in the summer.

TABLE 1

NUMBER OF DAYS WITH DUST STORMS

Stations	For April-October		By Month						
	Average	Maximum	Apr	May	Jun	Jul	Aug	Sep	Oct
Pugachev	5.5	13	0.1	0.4	1.2	1.1	1.1	1.5	0.1
Yershov	4.9	14	-	0.6	1.1	1.2	1.0	0.6	0.4
Saratov	2.9	7	0.1	0.2	0.5	0.8	0.5	0.4	0.4

For the Transvolga, the warm season of the year is characterized by a comparatively significant daily range of temperature, relative humidity, and windspeed. According to the meteorological conditions, dust storms most often occur after midday (between 13:00 and 19:00 hours), they begin less frequently between 7:00 and 13:00 hours (Table 2).

TABLE 2

THE RECURRENCE (in %) OF STORMS AT VARIOUS TIMES OF THE DAY AND THEIR DURATION (hours)

	Recurrence				Duration						
	Hours				April-October		By month				
Stations	1-7	7-13	13-19	19-1	Average	Maximum	May	Jun	Jul	Aug	Sep
Pugachev	1	43	47	9	1.9	7.5	1.5	0.9	1.2	2.2	2,9
Yershov	1	41	53	5	1.8	7.5	0.8	1.1	0.9	3.2	2,3
Saratov	0	33	60	4	1.3	5.2	0.4	0.7	0.7	1.4	2,6

The average duration of a storm is 1-2 hours; towards autumn, the duration often increases, mainly because of the drying up of the upper soil level. In a number of cases at Yershov and Pugachev, dust storms sometimes lasted for 6-7 hours (Table 2).

The monthly data on the recurrence and duration of dust storms must be considered as being approximate, since accurate data need a period of investigation of longer than 20 years.

Dust storms are closely linked with dry weather and especially with dry winds. In Yershov 67% and in Saratov 50% of the dust storms were registered in days when there was a dry wind or on a day directly after a dry wind. The remaining storms occurred in dry weather, but without dry winds.

When there is a dust storm, the weather is always dry (Table 3); on an average, the relative humidity of the air in Yershov and Pugachev was 30-33%, that is, 11-13% lower than the long-term average.

The windspeed during dust storms reaches 8 m/sec, exceeding the long-term average speed by 2-3 m/sec; often the wind increases to 17-20 m/sec and above. The wind direction during dust storms can be different, but at all stations there was an overwhelming number of south winds; fewer storms occurred when there was a wind from the north.

The average maximum temperature during dust storms for the whole warm season (from April until September) was approximately the same as the average maximum temperature of the air for July (27-28 degrees C); i.e., dust storms were accompanied by high air temperatures.

TABLE 3

WEATHER DURING DUST STORMS

Stations	At 13:00 Hours			Maximum Temperature of the Air (degrees C)
	Average Relative Humidity of the Air (%)	Average Wind Speed (m/sec)	Prevailing Wind Direction	
Pugachev	33	8	SSW	29.3
Yershov	30	8	SSW	28.2
Saratov	36	8	S	26.7

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The study of dust storms began in Russia at the end of the 19th century. Since 1936, systematic observations of this phenomenon were organized into the network of meteorological stations of the USSR Hydrometeorological Service. Meteorological stations record the duration of the dust storms, the speed and direction of the wind, horizontal visibility, and the character of the damages. The analysis of data obtained from dust storm observations and the comparison of these data with data obtained from soil humidity observations and the character of the vegetation made it possible to determine the causes responsible for the origin of dust storms and the distribution of the frequency of occurrence over the USSR.

Dust storms are one of the most dangerous meteorological phenomena threatening agriculture. They originate from both natural and anthropogenic factors, and they are frequently related to agricultural farming which is not suitable for the given climate zone. USSR steppe zones and a number of foreign countries have been damaged by dust storms. The strong dust storms over the European territory of the USSR, which occurred in the spring of 1892, 1928, and 1960 and in the winter of 1969, covered huge territories and caused considerable blowing of soil, damage to crops, and drift on roads. Dust storms occur much more frequently in isolated areas in the steppe zone.

The origin and development of dust storms are caused by a number of agrometeorological factors, including a strong wind (greater than 15 m sec^{-1}), dryness and dustiness of the top soil layer, the absence of or only a sparse vegetation cover in fields, and the presence of wide-open spaces. Usually dust storms occur when the relative humidity of the air is less than 50%. In a number of cases, the relative humidity drops to 10% (in isolated areas to 20%) causing dry winds in the summer. In winter, the above-mentioned factors include the absence of a snow cover, an ice rind, slight cementing and freezing of the soil to a shallow depth.

The set of factors mentioned occurs in steppe, semiarid, and desert zones. The northern extent of the dust storms coincides basically with the boundaries of the steppe zones along the line Kishinev, Poltava, Belgorod, Kuybyshev, Ufa, Chelyabinsk, Tara, Kemerovo. Isolated dust storm centers also occur in the valleys of eastern Georgia and in the Azerbaijan and Khakasskaya steppes.

In the steppe zone on the European territory of the USSR, the synoptic conditions causing dust storms originate during the movement of powerful anticyclones from the northwest to the southeast, with the simultaneous formation of cyclones in the Black Sea region. The most violent dust storms observed in 1892, 1928, and 1960 were formed in the presence of

the synoptic situation described. During the regeneration of the anticyclone and its slow movement, strong winds causing dust storms may last a long time as, for example, in January 1969. The winds originating on the anticyclone periphery are characterized by a lower relative humidity of the air causing rapid drying of the top soil layers.

Dust storms arise most frequently in the spring, when the force of the wind increases and when the fields are untilled or the vegetation on them is still in the early stage of development. Strong storms also occur in steppes toward the end of summer, when the soil is dry and the fields are tilled after the early spring harvest. Winter dust storms are a comparatively rare phenomenon. The most violent dust storms occurred in the winter of 1969 (northern Caucassus, eastern Ukraine).

Top soil layers begin to be blown when the speed of the wind is 8-10 m sec^{-1}. Soil particles are torn off from the surface by the wind; and the lighter particles carried by it in the form of dust over great distances, while heavier particles drop, displacing other soil particles that are drawn into the moving storm, as a result of which the blowing soil has a chain reaction character. The blowing rate of the soil is proportional to the cube of the windspeed. For example, when the speed of the wind increases from 12 to 15 m sec^{-1}, the blowing rate of the soil (erosion) increases almost by a factor of 2.

When the force of the wind decreases while it encounters obstacles (forests, buildings), the heavier particles drop, forming earth deposits. The lightest soil particles remain in the atmosphere in a suspended state for a long time. Therefore, visibility and illumination deteriorate during dust storms. Sun rays can hardly transilluminate the dust screen. Thus, in 1892, the dust which had risen on the northern Caucassus territory and in the Ukraine spread toward the northwest to the Baltic region. Dirt showers fell in Finland, Denmark, and Germany. The same phenomena were observed in the Ukraine and in the northern Caucassus during the strong snow storms in the spring of 1960 and in January-February of 1969. The height of the dust deposits near obstacles was 1-1/2 m.

The drying of the top soil layer, enhancing the formation of dust storms begins in the steppe zone in early spring. In 50% of the years, the soil layer dries to a loose state to a depth of 10 cm before April 30, south of the line Kirovograd, Dnepropetrovsk, Voroshilovgrad, Volgograd; on 10-15 April to the south of the Odessa, Nilolayevskaya, Khersonskaya, Zaporozhskaya and Rostovskaya regions; and toward the end of March, in the north and northeast Krasnodarsk and Stavropol' province and in isolated areas. In individual years (10% of the total number of years), this layer dries to the loose state 10 to 20 days earlier than the dates mentioned.

In western Siberia, in 50% of the total number of years the soil layer dries to a depth of 10 cm before 1 July south of the line Chelyabinsk, Kurgan, Tara, Novosibirsk, Kuznetsk; and before 20 May, and in northern Kazakhstan.

Since the force of the wind in the steppe zone increases in the spring, conditions for the formation of dust storms are created during the drying of the top soil layer. The formation of spring dust storms is also enhanced by the fact that large field areas which are being prepared for spring sowing are still in the untilled state or are only partially shielded by sprouts.

The dust storm zones on the territory of the Soviet Union are classified on the basis of their frequency distribution throughout the year. On the average, the number of dust storms per year varies within wide limits; the smallest number occurs near the boundary of the steppe zone, and the largest number occurs in sand deserts.

The average number of days with a dust storm over many years is entered on Figure 1.* The figure shows that the northern boundary to which the dust storms spread on the territory of the Soviet Union (on the average 1 day per year) coincides basically with the boundary of the steppe zone along the line Kishinev, Poltava, Belgorod, Kuybyshev, Ufa, Chelyabinsk, Tara, Kemerovo. Individual dust storm centers also occur in the valleys of eastern Georgia, the Azerbaijan and Khakasskaya steppes and in the Tuvinskaya Autonomous Soviet Socialist Republic.

The number of days with dust storms in a large part of the Ukrainian steppe zone varies between 1 and 5. Beyond the boundaries of this zone, 1 to 2 days with dust storms also occur in some portions of the Vinnitskaya, Zhitomirskaya and Kievskaya regions (on light soils). Dust storms with a 6- to 10-day recurrence rate per year occur on Ukrainian territory in four areas: southwest in the Odessa region, in the Crimean steppe regions, in the Voroshilovgradskaya region, and the fourth region, which is largest in area, encompasses the southern portions of the Nikolayevskaya and Khersonskaya regions, the western Zaporozhskaya region, and a part of the Dnepropetrovskaya region.

In the northern Caucassus steppe areas, the number of days with dust storms is predominantly 1 to 5; in the southeast portion of the Rostovskaya region in the northeast Stavropol' province, it is more than 10 days; and in isolated areas 15 to 20 days. In the regions beyond the Volga, in the Volgogradskaya and Saratovskaya regions, the number of days with dust storms increases from

*The map for the number of days with dust storms on the territory of the main USSR agricultural regions was compiled by Yu. I. Chirkov and M. M. Agafonova.

5 to 10 days in a west-to-east direction. In Kazakhstan, the frequency distribution of dust storms is exceptionally varied. Foci with dust storms observed for more than 40 days per year are located in the Caspian regions of the Gur'yevskaya region, in the Aral regions in the Aktyubinskaya and Kzyl-Ordinskaya regions, and in the western semiarid portions of the Karagandinskaya region. In northern Kazakhstan, the number of days with dust storms is greater than 10 in most cases; and in individual areas, it is as high as 30.

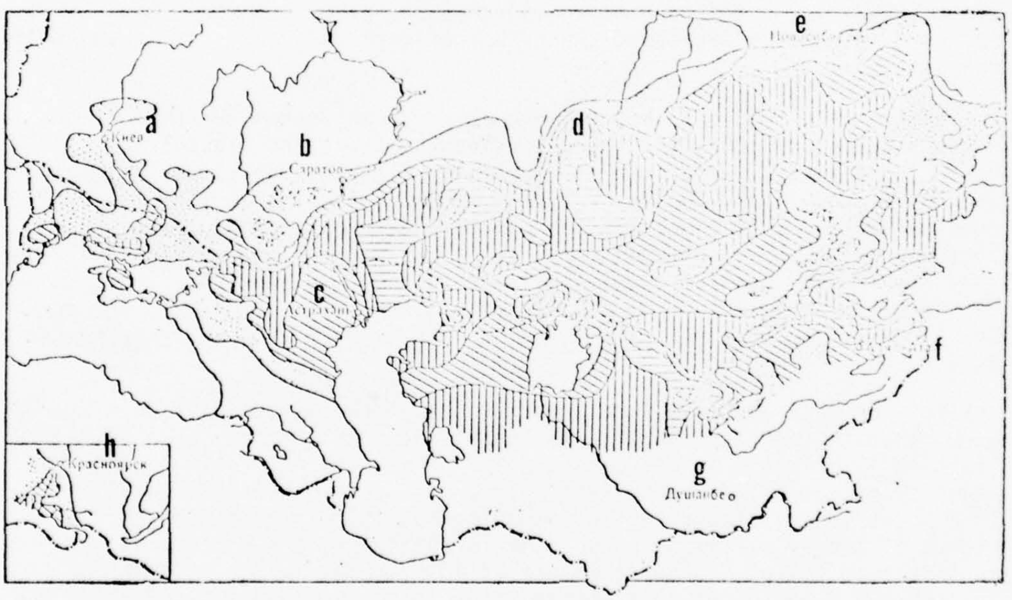

Figure 1. Number of days with dust storms on the territory of the main USSR agricultural regions.

1-5 days	Key: a. Kiev
6-10 days	b. Saratov
11-20 days	c. Astrakhan
20-40 days	d. Kustanay
more than 40 days	e. Novosibirsk
—x— solid snow cover boundary	f. Alma-Ata
	g. Dushanbe
	h. Krasnoyarsk

In the southern portions of the Omsk region, in the southwest Novosibirskaya region, and in the western Altai province, the number of days with dust storms varies between 15 to 20 and in isolated areas up to 25.

The frequency distribution of dust storms calculated separately over the 1954-1955 period and after this period (until 1965) indicates a considerable increase in the number of days with dust storms (2 to 3 times as many) in the northern Kazakhstan regions and in southwestern Siberia. This is explained by the absence of a natural vegetative cover due to the mass tilling of soils without measures protecting the soil from wind erosion (plowing without a grader, retention of stubble, etc.). In recent years (1967-1969), the countererosion measures used on large areas in northern Kazakhstan decreased the number of days with dust storms and their duration.

For example, in 1968 dust storms were observed on 20 and 28 April in the north Kazakhstan, Kokchetavskaya, Tselinogradskaya, and Pavlodarskaya regions, in early June in the Kokchetavskaya and Kustanayskaya regions, and on 16 June in the Tselinogradskaya region. Local dust storms were observed in isolated spots predominantly in October and November 1969. Their duration varied predominantly from 1 to 5 hours and only on 3-4 June they covered the Pavlodarskaya, Tselinogradskaya and partially the Kokchetavskaya regions where they continued for 10 to 12 hours. The number of days with dust storms in 1968 is much smaller than the mean number over many years (by 30 to 60%).

Analysis of data obtained from observations of the duration of dust storms shows that in the majority of cases short local dust storms are dominant (lasting less than 5 hours, observed during daylight hours). In the majority of cases, the probability for a dust storm duration from 5.5 to 10.4 hours in dry steppe regions is 30 to 60%. The probability of dust storms of longer duration in the zone in which they are most prevalent is less than 10% of the total number of dust storms in the majority of regions. A duration of dust storms which is greater than 20 hours per day is a comparatively rare phenomenon. This is due to the diurnal force of the wind increasing during daylight hours and decreasing at night. The probability of dust storms at different hours of the day is represented graphically in Figure 2.

The correlation between the change in the windspeed within 24 hours and the intensity of the dust storms is comparatively high, which also applies to the correlation between the number of days with dust storms and the number of days with a strong wind, especially in the spring.

Therefore, the longest dust storms occur as a rule in the spring. The distribution of the number of days with dust storms over a year is highly irregular and it has primarily a zoned character. The curve for the frequency distribution of the number of days by month is characterized by one

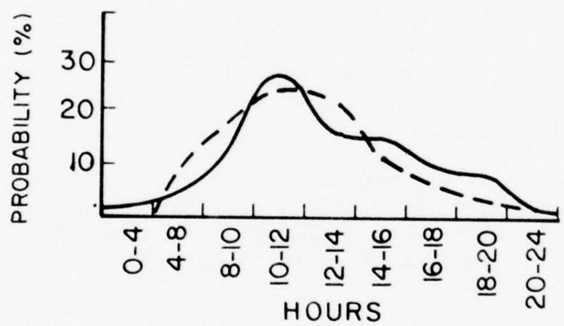

Figure 2. Probability of dust storms at different hours of the day.

—— Voroshilovgrad

- - - Kherson

or two modes. In the first case, the maximum number of dust storms occurs in the spring; and in the second case, toward the end of summer. This is related both to the distribution of the number of days with a strong wind by month and also to the character of the moist soil, the precipitation regime, and the character of the ground surface.

In the Ukraine, the predominant type of dust storm distribution by month is a distribution with two modes, the first maximum occurring in April-May (in the Crimean region in March and April) and the second in June-August. The first maximum occurs during intensified wind activity in the spring and the rapid drying of large tilled soil areas. The second maximum occurs during increasing dryness toward the end of summer. The same character of the distribution of the number of days with dust storms is observed in the Stavropol province, the Checheno-Ingushkaya Autonomous Soviet Socialist Republic and in the Rostovskaya and Astrakhanskaya regions.

In the Krasnodark province, the maximum number of dust storms occurs in April; whereas in the summer, dust storms are observed only rarely. In the southern regions of west Siberia and in north Kazakhstan, a unimodal type of distribution is predominant, with the maximum occurring in May and in some regions in May-June.

Winter dust storms occur infrequently. Their recurrence rate in the south European territory of the USSR is 1 to 2 times or less every 10 years.

Literature sources mention the winter dust storms of 1885-86 during which from January to mid-February the fields under the winter crops were blown out to the depth of the tilling layer by strong north and northeast winds, attaining occasionally the force of a hurricane. In the winter of 1890-91, the strong northeast winds, accompanied by drifts, caused earth and snow shifts and destruction of crops over considerable areas. In 1892-1893, black storms were observed in December and January. Blowing soil was noted in a number of areas within the Rostovskaya region in the winter of 1950-51. Dust storms lasting 15 to 30 hours passed through the south European territory of the USSR in January 1964 and January 1965.

The January and February 1969 dust storms, which covered a considerable part of the Ukraine, the northern Caucassus, and the Nizhneye Povolzh'ye were the longest, most violent, and destructive of all winter dust storms within the last 80 to 90 years. Their origin and development were enhanced by an exceptionally unusual synoptic situation. During November and the greater part of December, a powerful blocking anticyclone above the northeast Atlantic Ocean caused warm dry weather in the south European territory of the USSR, preventing the formation of a snow cover.

Toward the end of December, the general circulation was rearranged. A powerful Siberian anticyclone began to move southwest, and arctic air masses were moving rapidly to the southeast European territory of the USSR. During January and February, hurricane winds were observed in the south European territory of the USSR in conjunction with the regeneration of the Siberian anticyclone, which interacted with the dry, barely frozen soil not covered by snow and caused very violent dust storms.

The longest dust storms were observed from 2 to 7-8 January 1969 on the territory including the Zaporozhskaya, Donetskaya regions, a part of the Khersonskaya region, the Nikolayevskaya, Dnepropetrovskaya, Rostovskaya and Volgogradskaya regions, the Stavropol'sk and Krasnodarsk province, and the Crimean steppe regions. The windspeed was as high as 40 m sec^{-1}. The duration of a wind exceeding 25 m sec^{-1} was from 30 to 70 hours. In some regions of the Krasnodarsk province, the dust storms lasted 2 to 3 days; and in the Rostovskaya region, 5 to 6 days. In February 1969, dust storms caused by long-lasting hurricanes occurred again in these regions.

In the Ukraine in a number of regions of the Dnepropetrovskaya and Zaporozhskaya regions, the total duration of dust storms in February was 150 to 220 hours in isolated spots at a 20 to 30 m sec^{-1} windspeed, and on some days at a 35 to 40 m sec^{-1} windspeed.

East of the Ukraine, the dust storms covered the territory from the Don basin in an easterly direction almost to the Volga and also a part of the Krasnodarsk province. The duration of the dust storms over this territory varied from 80 to 100 hours in the southern regions and from 40 to 60 hours in the northern regions.

The effect of dust storms can be estimated by using a complex index which was calculated in the Central Geophysical Observatory on the basis of data pertaining to the speed of the wind and the duration of the dust storm. The calculations considered the fact that the rate at which the destruction and blowing of the soil occurs is characterized by the force of the dust stream and proportional to the cube of the speed of the wind. A windspeed of 12 m sec^{-1} and a duration of 12 hours was taken as the unit destructive work of the dust stream. On the basis of these calculations, the work of the dust stream was 60 and even 100 units in the lower Don region and in the eastern and northern Azov region, 30 to 40 units in the Don and Volga delta, and 1 to 2 units only in the northern part of the Rostovskaya region.

Studies of damages to crops caused by dust storms have shown that the probability for their origin is determined not only by the synoptic and agrometeorological factors but also by the counter erosion measures taken. This must be considered in a forecast of dust storms and in an evaluation of their harmful effect on agricultural yield. A study of the state of the crops after the 1969 winter dust storms made from an aircraft by

G. I. Borisoglebskiy and D. P. Bespalov showed that an inverse relationship exists between the damage to the crops and the tree density in the fields. It is evident from the data presented in Table 1 that the smallest damage to crops occurred along the Rostov-on-the-Don/Svetlograd route with 45 to 50 forest belts per 100 km. The greatest damage to crops occurred on the Elista-Zimovniki, Manych route. Along this route there are 10 to 12 forest belts per 100 km. Therefore, a more accurate evaluation of the conditions under which dust storms originate in regions in which the probability of this phenomenon is great requires data on the degree of aforestation in fields.

The mechanical composition of the soil is known to affect the formation of dust storms. Light soils undergo a greater degree of blowing, and they also dry faster. Therefore, the diagnostics for the formation of dust storms are also facilitated by considering the differences in the soils. Information on the condition of the soil (frozen, damp, slightly damp, dry) is of great importance in the forecast of dust storms. This information, which is transmitted from the network of meteorological stations, can facilitate the detection of centers in which dust storms originate. Figure 3 shows the regions where the top soil layers are in the dry (loose) state during dust storms. Generally these regions are close to the area where the dust storms originate. The map (Figure 3) for the spread of the dust storms on 8-10 March in the northern Caucassus on a background map with different conditions of the soil presented as an illustration confirms this relationship.

To evaluate the effect of dust storms on agricultural crops, the degree of development of the vegetation in the fields must be considered. The results obtained from studies of winter crops during dust storms have shown that underdeveloped crops, which have not yet reached the blowing stage, are damaged most heavily.

Well branched-out crops create considerable obstacles to the wind on the field surface and weaken the blowing of the soil. Soil deposits, carried by the air current, are observed more frequently on well branched-out crops than blowing soil. Underdeveloped crops are damaged most heavily by blowing, representing the principal type of damage.

An analysis of the conditions under which dust storms are formed and the data on the damages they caused show the necessity of taking measures which reduce the force of the wind near the top soil and increase the adhesion of soil particles.

These measures include the planting of a network of forest bands and other windbreak strips, which reduce the force of the wind, the retention of stubble, ploughing without a grader, and the use of chemical compounds improving the adhesion of soil particles.

TABLE 1

Aforestation of Fields and Degree of Damage to Winter Crops Caused by Soil Erosion in the Winter of 1969 (based on the results of a study made from an aircraft on 1-2 March 1969)

Route	Number of Fields Studied	Length of Route, km	Number of Fields Studied per 100 km	Percentage of Fields with Different Degree of Damage to Crops		
				Slight	Medium	Heavy
Rostov-on-the-Don--Zaventnoye	149	350	10-12	9	16	74
Rostov-on-the-Don--Svetlograd	281	400	45-50	85	14	1
Elista--Zimovniki	95	320	10-12	6	14	80
Manych-Bashanta--Rostov-on-the-Don	132	250	30-40	74	20	6

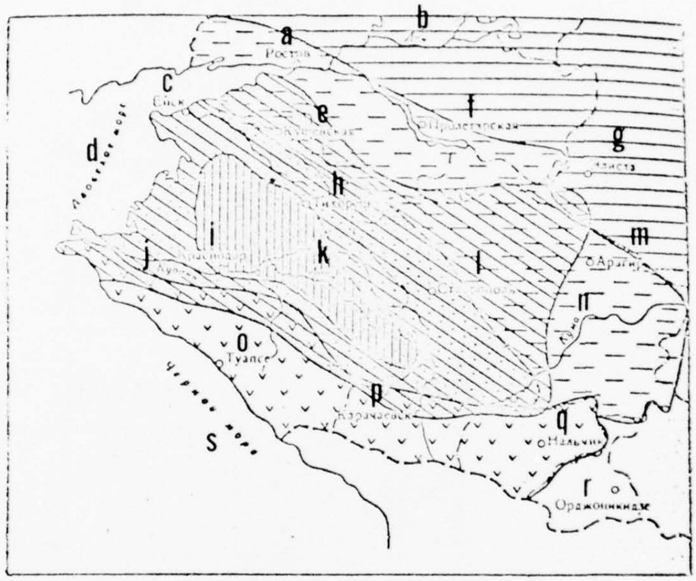

Figure 3. Condition of top soil layer (0-2 cm) near zone where dust storms were formed in the northern Caucassus on 8-11 March 1970.

Condition of soil:

- frozen
- frozen at night, thawed during daytime
- damp
- dry

Number of hours with dust storms:

- exceeding 20 .
- exceeding 40

Key:

a. Rostov-on-the-Don	k. Laba
b. Don (River)	l. Stavropol'
c. Yeysk	m. Arzgir
d. Sea of Azov	n. Kuma
e. Kushevskaya	o. Tuapse
f. Proletarskaya	p. Karachayevsk
g. Elista	q. Nal'chik
h. Tikhoretsk	r. Ordzhonikdze
i. Krasnodar	s. Black Sea
j. Kuban	

The direction of the prevailing winds, the relief, the microclimate characteristics of the fields, and the specific features of the soils must be considered in the development of measures to combat dust storms.

Preliminary analysis has shown that in the periods in which (according to the climate conditions) the dust storms are most probable, their possible origin can be determined on the basis of the following agrometeorological predictors: (1) the absence of deposits within 5 to 6 days, (2) low relative humidity of the air (below 50% during daytime), (3) excessive dryness of the top soil layer (productive moisture reserves in the 0-10 cm soil layer below 20 mm), (4) presence of large areas of tilled soil or soil slightly covered with vegetation, and (5) absence of a snow cover on fields and weak cementation of the top soil layer.

The presence of these conditions indicates the possible origin of a dust storm as soon as the synoptic situation causes high pressure gradients. In this case, a strong wind forecast is also a forecast of the origin of a dust storm.

At the present time, in conjunction with the development of new techniques to combat soil erosion by increasing the adhesive force of soil particles in a short time, a forecast with a 2- to 3-day lead time can be of great practical importance.

Dolgilevich, M. I., 1966, "Dust Storms of the Ukraine," Izv. Akad. Nauk SSSR, Ser. Geograph. (Moscow), No. 1, 34-40.

On the vast territories of the Ukraine, dust storms, one manifestation of wind erosion of soil, occur almost annually. In the last 40 years, the most destructive dust storms, which covered considerable portions of the Ukraine, occurred in 1928, 1929, 1930, 1936, 1939, 1946, 1948, 1951, 1953, 1957, 1959, 1960, and 1962.

In the Ukraine, in times of dust storms, agricultural crops are damaged and destroyed. Great masses of fine, upper layer soil, the most fertile part, are being carried away into ditches, washed away into rivers and the sea, or accumulated by the forest strips. This very fine soil covers perennial plants, homes, farm buildings, railroads, and highways. Damages to the national economy brought on by the dust storms on the Ukraine are beyond any calculation. However, the statistical data at our disposal shows that in five districts of the steppes of the Ukraine, for the period from 1950 to 1956, dust storms damaged and destroyed more than 350,000 and in 1960 even near one million hectares of agricultural crops.

Soil and crops can be protected from dust storms if the measures taken to save them are based on the physical and geographical conditions that cause dust storms.

There are a number of papers which examine the most forceful dust storms which appeared in the southern part of the Russian Plains in the last 75 to 80 years. A. G. Doskach and A. A. Trushkovskyy reviewed these materials.

However, some questions were left unanswered, such as: in which areas do the dust storms occur? At what times of year do they occur? What regularity is there in the genetical links of natural conditions which influence the formation of dust storms and their intensity? This paper deals with these questions, supporting them with data processed by us from 178 weather stations for the period from 1943-1962.

Figure 1 presents the general view of the distribution of days with dust storms on the Ukraine. This map-chart shows that dust storms form not only in the regions of the steppe but also in the woodlands of the Ukraine. Dust storms in the Ukrainian woodlands quite often cause loss of agricultural crops grown on a turf-sand soil. This author often observed the loss of sprouts of lupine, rye, and other crops on the turf-sand soils of the woodlands. In the same zone, deflation occurs on the dried-out peat bogs, especially during dry spells in the summer.

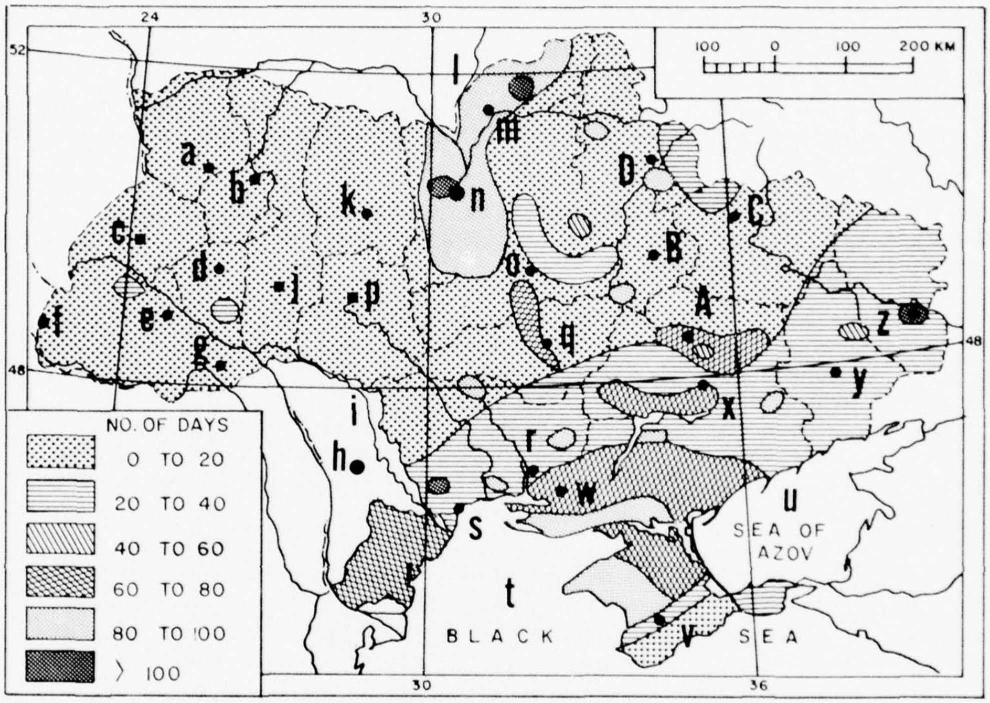

Figure 1. Number of days with dust storms in the Ukraine (for 20 years).

Key a.	Lutsk	p.	Vinnitsa
b.	Rodno	q.	Kirovograd
c.	L'vov	r.	Nikolayev
d.	Ternopol'	s.	Odessa
e.	Stanislav	t.	Black Sea
f.	Uzhgorod	u.	Sea of Azov
g.	Chernovtsy	v.	Simferopol
h.	Kishinev	w.	Kherson
i.	Dnestr	x.	Zaporozh'ye
j.	Khmel'nitskii	y.	Donetsk
k.	Zhitomir	z.	Lugansk
l.	Dnepr	A.	Dnepropetrovsk
m.	Chernigov	B.	Poltava
n.	Kiev	C.	Khar'kov
o.	Cherkassy	D.	Sumy

In the steppe zone, the southwestern and central regions are noted as regions of deflation where the number of days with dust storms for 20 years is more than 100, or more than 5 annually. On stations in Kherson, Berislav, Nizniy Serogoz, and Bot'vo, the days per year are, respectively, 10, 12, 17, and 11.

In the woodlands is noted the western part of the northeastern (Dymerskyi-Shostkinskyi) agricultural soils region where the number of days with dust storms in 20 years reaches 60.

Over a large part of the Ukraine, particularly in the woodlands and the forest-steppe regions, the number of days with dust storms is not significant. In accordance with natural zones in the Ukraine, the number of days with dust storms generally increases from north to south. This increase is, of course, dependent on the actual distribution of moisture across the territory. In the same direction atmospheric precipitation decreases from 550 to 350 mm. The coefficient of precipitation is from 1 to 0.5.

The timing of the formation of the storms within the limits of a natural zone has great significance for agricultural purposes. Many analysts, observing comparatively frequent repetition of dust storms in the south of Russia (Ukraine), emphasized that dust storms emerge generally in winter and spring (Vysotzkyi, 1894; Saradinaki, 1894; and Vorov'ev, 1930).

Figure 2 shows that during a year there are both uni- and bi-model distributions of the number of days with dust storms. In the woodlands and the forest-steppe, the maximum number of days with dust storms occurs in May and June (20-25%); but in the steppe, the first maximum appears in April (19-20.5%) and the second in August (15-17.4%). Notice that in all natural zones in the Ukraine dust storms emerge in warm seasons. Only in the southern steppe do storms emerge in March, and then only about 10% of them.

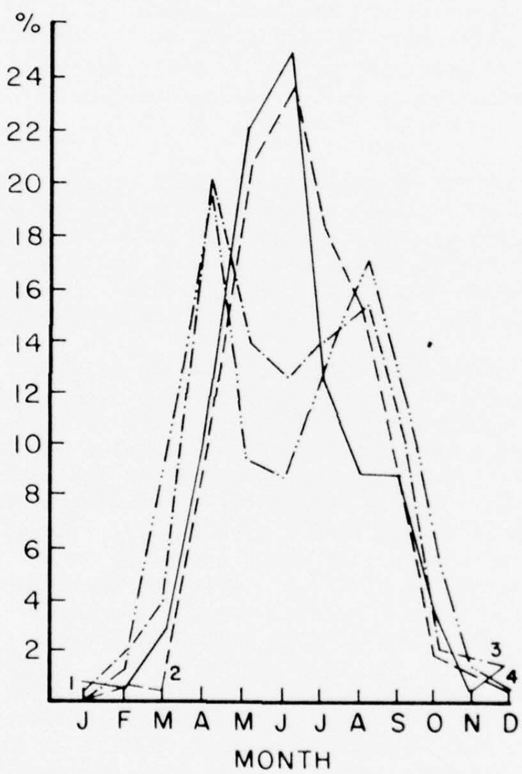

Figure 2. Number of days with dust storms in Ukrainian natural zones (according to 30 weather stations in the zones for 20 years).

Some differences in the times of appearance of dust storms in those or other zones are explained by different calendar timing of the approach of the warm season in that zone. While sometimes soil deflation is observed at the beginning of April in the southern steppe, as it has begun to dry out a bit, there is still snow in some parts of the woodlands. In the spring, the reserve of water per meter of soil under the winter crops reaches 200 in the woodlands. In the southern steppe, it reaches only 75-100 mm.

Most dangerous are the spring dust storms which occur when large areas of the autumn ploughing are not yet protected by agricultural crops. These areas serve as breeding grounds for the dust formation, which, when carried over to the adjacent field, causes deflation in soils which are well covered by established winter crops. Fields which are sown but have weak crop shoots and dust-like soil also serve as breeding grounds of deflation.

In this connection, it is interesting to see the map-chart of the number of days with dust storms in the spring (Fig. 3). The northern border of spring dust storms, with more than 20 in 20 years, or more than one per year, is parallel and somewhat south of the northern border of the steppe. This means that deflation occurs in the spring in the whole zone of brown soils and southern soils (which are partly mixed with ordinary chernozem, black soil.) The whole steppe can be divided by a line stretched in the crosswise direction of the subzone which shows the number of days with dust storms. An examination of the gradation of these subzones from north to south shows that in the northern subzone, characterized by ordinary and southern chernozem, the number of days with dust storms is 20 to 40. In the next subzone the number increases to 80 to 100. However, in the next subzone of dark-brown and brown alkaline soils, the number of storms decreases to 20 to 40. In the steppe of Crimea, the number of days with dust storms increases and then decreases in the direction to the mountains. In the eastern part of the Priazovkiy lowland, that adjacent to the Donets mountain ridge, dust storms occur less often.

Let us examine why circumstances favorable to wind conditions on the Ukraine arise in the spring. Figure 4 shows the number of days with strong winds (>15 m/sec). The greatest number of days with strong winds (greater than 12) is in the southeastern part of the steppe's zone and also in the southwestern part. The left border of the steppe has a greater number of days with strong winds than the right border. Earlier it was noted that on an especially large number of days strong winds occur on the eastern part of the Ukraine, on the coast of the sea of Azov (Dubenzov, 1956). The eastern part of the Crimean steppe is characterized by more frequent and stronger winds than the western (Fig. 5). Such consistency of wind conditions in the spring creates prerequisites for the development of wind storms in the regions where there are other favorable circumstances for them.

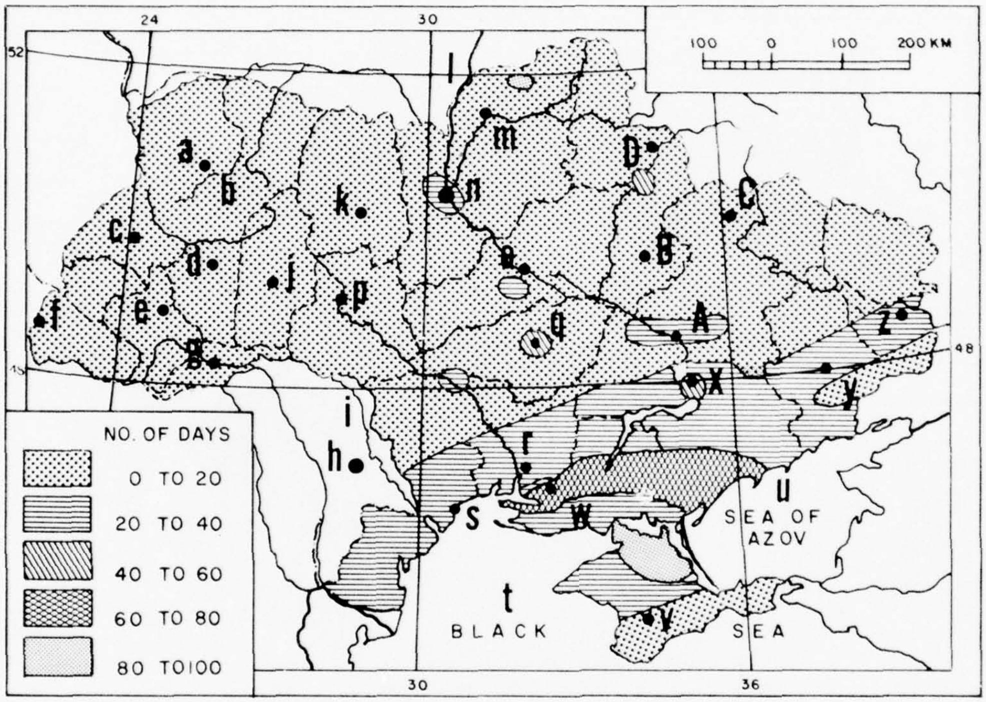

Figure 3. Distribution of dust storms in Ukrainian natural zones during spring.

Key

a.	Lutsk	p.	Vinnitsa
b.	Rodno	q.	Kirovograd
c.	L'vov	r.	Nikolayev
d.	Ternopol'	s.	Odessa
e.	Stanislav	t.	Black Sea
f.	Uzhgorod	u.	Sea of Azov
g.	Chernovtsy	v.	Simferopol
h.	Kishinev	w.	Kherson
i.	Dnestr	x.	Zaporozh'ye
j.	Khmel'nitskii	y.	Donetsk
k.	Zhitomir	z.	Lugansk
l.	Dnepr	A.	Dnepropetrovsk
m.	Chernigov	B.	Poltava
n.	Kiev	C.	Khar'kov
o.	Cherkassy	D.	Sumy

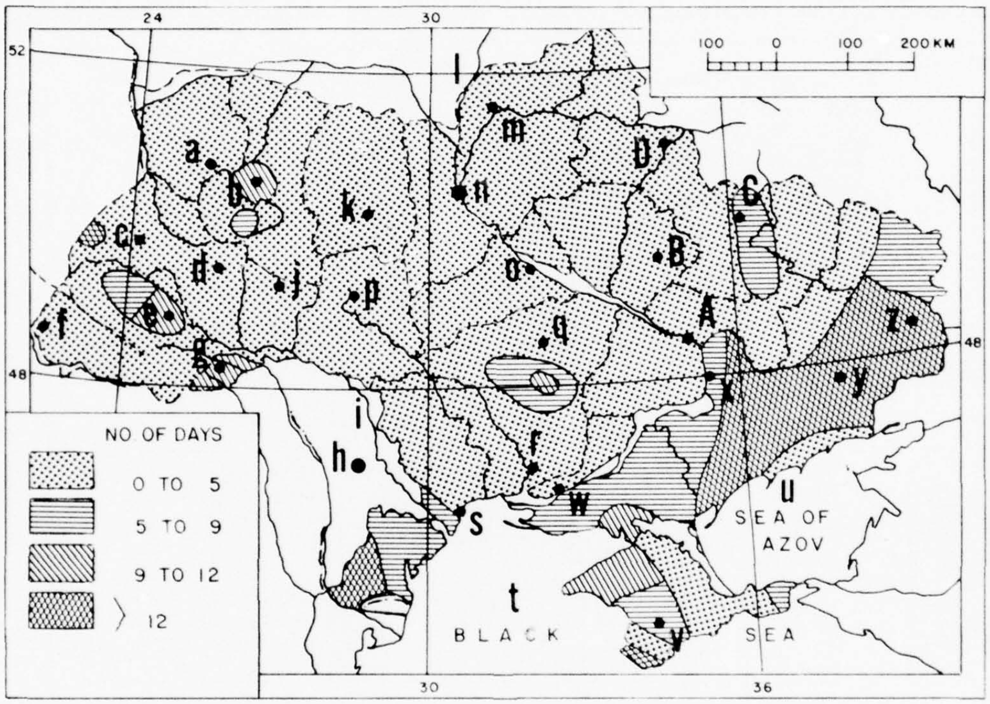

Figure 4. Number of days with dust storms on the Ukraine (for 20 years) (with wind speed greater than 15 m/sec).

Key
a. Lutsk
b. Rodno
c. L'vov
d. Ternopol'
e. Stanislav
f. Uzhgorod
g. Chernovtsy
h. Kishinev
i. Dnestr
j. Khmel'nitskii
k. Zhitomir
l. Dnepr
m. Chernigov
n. Kiev
o. Cherkassy
p. Vinnitsa
q. Kirovograd
r. Nikolayev
s. Odessa
t. Black Sea
u. Sea of Azov
v. Simferopol
w. Kherson
x. Zaporozh'ye
y. Donetsk
z. Lugansk
A. Dnepropetrovsk
B. Poltava
C. Khar'kov
D. Sumy

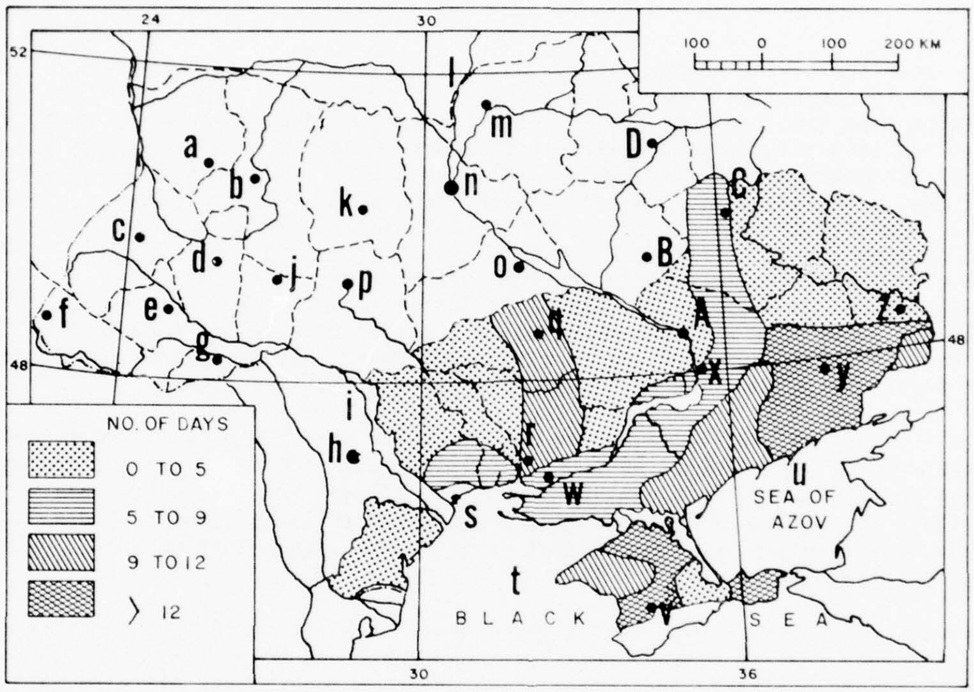

Figure 5. Average annual number of days with strong winds in the Ukraine in spring.

Key
a. Lutsk
b. Rodno
c. L'vov
d. Ternopol'
e. Stanislav
f. Uzhgorod
g. Chernovtsy
h. Kishinev
i. Dnestr
j. Khmel'nitskii
k. Zhitomir
l. Dnepr
m. Chernigov
n. Kiev
o. Cherkassy
p. Vinnitsa
q. Kirovograd
r. Nikolayev
s. Odessa
t. Black Sea
u. Sea of Azov
v. Simferopol
w. Kherson
x. Zaporozh'ye
y. Donetsk
z. Lugansk
A. Dnepropetrovsk
B. Poltava
C. Khar'kov
D. Sumy

A comparison of the number of days with strong winds to the number of storms in the spring shows that, in general, dust storms occur over the steppe zone simultaneously with frequent strong winds. However, in some regions this relationship between the number of days with strong winds and dust storms does not exist, which indicates that an index like the number of days with strong winds cannot always serve as a basis for judgment of the intensity of wind erosion in the specific area. Above we noted that it is necessary to consider a number of factors causing deflation. However, there are main factors which determine its intensity. For example, let us examine the conditions for deflation in the Ukraine in the spring of 1960 when the emerging dust storms covered not only the steppe but also a part of the forest-steppe zone. Meteorological conditions of these dust storms are well described by V. A. Kulikov (1961).

The intensity of deflation may be judged by the percentage of destroyed and damaged crops per general land under cultivation. The damage to the sowing area in this period is shown on Figure 6, which was compiled on the basis of data on conditions in the sowing areas after the dust storms. These data were furnished by the regional agricultural administration and National Insurance.

Average and above average intensity of dust storms is noted in the northern and western regions of the Odessa and Dnepropetrovsk districts; in the northeastern, eastern, and southeastern parts of the Kherson district and the Crimean steppes (with the exception of the western extremity); in the southern and southeastern parts of the Zaporozh'e district; in the southern and northern parts of the Donets district; and in the southern half of the Lugansk district. Separated breeding grounds with average and above average intensity of dust storms were noted in the central and northwestern parts of the Lugansk district.

Weak intensity of dust storms was noted in the central and eastern parts of the Odessa district; in the southern and central parts of the Nikolaev district; in a broad strip adjacent to the left bank of the Dnepr in the southwestern part of the Kherson district; on the western extremity of the Crimea; in almost all of the Dnepropetrovsk district; in the central, western, and the two regions of the eastern part of the Zaporozh'e district; in the southwestern and northwestern parts of the Khar'kov district; in the central and western parts of the Donets district; and in almost all of the Lugansk district except for that noted above. Over the rest of the Ukraine, dust storms were very weak or did not manifest themselves at all.

To characterize the conditions of deflation in this period, chart-maps have been compiled showing the reserves of water in the ploughed layer of the soil (Fig. 7), the number of days with strong winds, and the speed of the wind. These data are combined with the characteristics of the topsoil in that or other regions which were judged according to the plane tables

of the State soil maps of the USSR. Analysis of this material has shown that a definite relationship exists between the nature of the topsoil, the reserve of water in it, the average speed and duration of the wind, and the intensity of the dust storms within the borders of the territory in review. The low reserve of moisture (<20 mm) and comparatively great speed of the wind (>16 m/sec) caused the emergence of intensive dust storms on soils whose composition is quite different, such as rich chernozem (black soil), average humus, southern chernozem, dark-brown soil, dark-brown with alkali, and the heavy textured, alkaline earth of the steppe.

The duration of strong winds is conducive to sharp increases in intensity of dust storms when the following conditions exist: the same reserve of water in the soil, the same type of soil, and the same wind speed.

When there is the same nature of topsoil with increased level of water reserve in the soil and low speed and low duration of the wind, dust storms of great intensity do not appear.

Areas of alkaline earth under the same conditions of moisture and speed and duration of wind, by comparison with adjacent areas with different soils, had a low intensity of dust storms. Rich chernozem has shown greater resistance to being blown away than ordinary chernozem adjacent to it. Sandy soils even with a high content of reserves of moisture and low wind speed raise dust easily.

In general, it was discovered that the reserves of water in the soil play the main role in the formation of dust storms. Low levels of moisture combined with strong, durable winds determine intensive expulsion of soils.

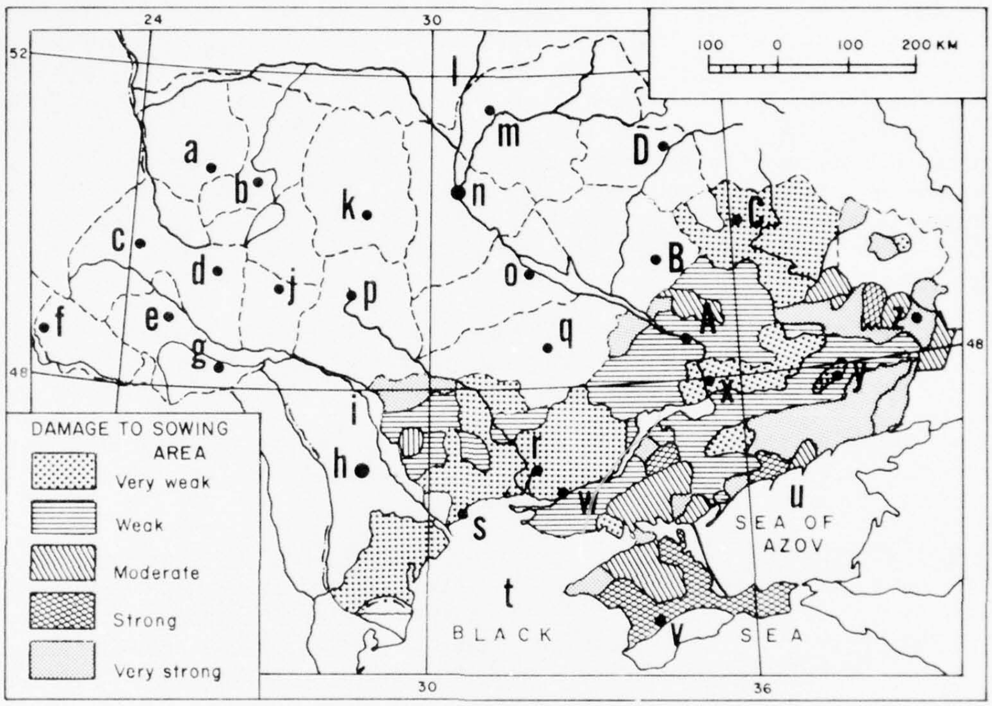

Figure 6. Agricultural crop damage due to dust storms in 1960.

Key

a.	Lutsk	p.	Vinnitsa
b.	Rodno	q.	Kirovograd
c.	L'vov	r.	Nikolayev
d.	Ternopol'	s.	Odessa
e.	Stanislav	t.	Black Sea
f.	Uzhgorod	u.	Sea of Azov
g.	Chernovtsy	v.	Simferopol
h.	Kishinev	w.	Kherson
i.	Dnestr	x.	Zaporozh'ye
j.	Khmel'nitskii	y.	Donetsk
k.	Zhitomir	z.	Lugansk
l.	Dnepr	A.	Dnepropetrovsk
m.	Chernigov	B.	Poltava
n.	Kiev	C.	Khar'kov
o.	Cherkassy	D.	Sumy

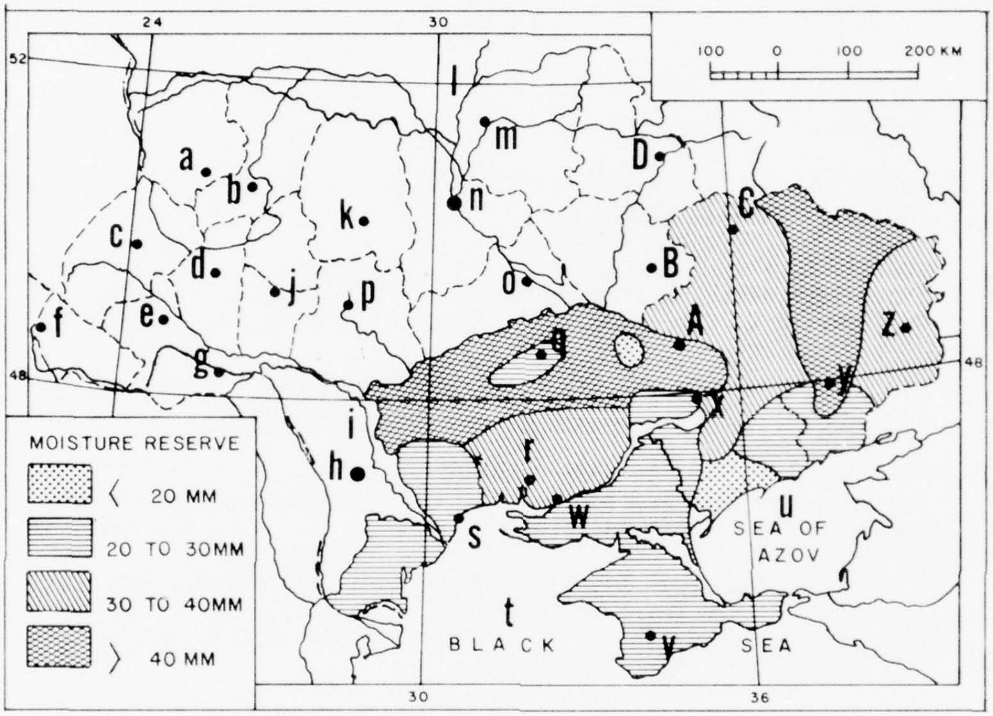

Figure 7. Moisture reserves in the plowed surface layer of soil in the spring of 1960.

Key

a.	Lutsk	p.	Vinnitsa
b.	Rodno	q.	Kirovograd
c.	L'vov	r.	Nikolayev
d.	Ternopol'	s.	Odessa
e.	Stanislav	t.	Black Sea
f.	Uzhgorod	u.	Sea of Azov
g.	Chernovtsy	v.	Simferopol
h.	Kishinev	w.	Kherson
i.	Dnestr	x.	Zaporozh'ye
j.	Khmel'nitskii	y.	Donetsk
k.	Zhitomir	z.	Lugansk
l.	Dnepr	A.	Dnepropetrovsk
m.	Chernigov	B.	Poltava
n.	Kiev	C.	Khar'kov
o.	Cherkassy	D.	Sumy

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Wind erosion of the soil appears in diverse forms, but the most intense form is the dust storm. The mean number of days with dust storms in Western Siberia is from 0.2 to 34 per year. The largest number of days (11 to 34) was noted in the arid and northern steppes of Kulunda. In the northern section of the steppe and in the southern forest-steppe, there are observed, on the average, 3 to 9 dust storms, and in the northern forest-steppe, from 0.2 to 3 each year (Fig. 1).

The average windspeed during the dust storms ranges from 5.4 to 12.9 with a maximum of 11 to 46 m/sec (Table 1). The average yearly number of days with strong winds is, as a rule, much greater than the number of days with dust storms. The strong winds do not always cause dust storms. The moist soil in the fall and the snow-covered soil of winter resist the strong winds. Under the conditions of Western Siberia, dust storms arise primarily in the warm season of the year. During dust storms, the air temperature reaches 19.6° to 27.4°C. Dust storms arise most often when the air temperature exceeds 15°C. Strong dust storms appear in the arid years, when the number of storms increases by a factor of 2. In the past 20 years (1950-1970), there were 11 such years (1951, 1952, 1953, 1955, 1962, 1963, 1964, 1965, 1967, 1968, and 1969). I. S. Smetanin (1957) noted that for the steppe zone of Western Siberia, alternation of dry and humid years of several years' duration is typical, which is the cause of the pulsating nature of the appearance of wind erosion. We selected 2 arid periods from the past 20 years: 1951-1955 and 1962-1969. The minimum relative humidity of the air during dust storms was, as a rule, from 20 to 40%.

The periodicity of the dust storms was also connected with the plowed land and the system of cultivation. We selected three periods from the series of 30-year observations: 1940-1954, prior to the mastering of the virgin lands; 1955-1966, after the mastering of the virgin lands; and 1967-1970, the massive transition period to the new technique of cultivating the soil. After the mastering of the virgin lands, the number of dust storms increased but after the intrusion of the noncarrying-away cultivation of the soil, they diminished somewhat (Table 2).

During the years, the dust storms fluctuated within broad limits. In the black-earth zone (Cherlak, Omsk), there might be from 1 to 45, while in the chestnut zone (Slavgorod, Klyuchi), from 1 to 54. In the regions of semisandy and sandy soil, the number of dust storms fluctuated from year to year within narrower limits, but the average several-year number was very large.

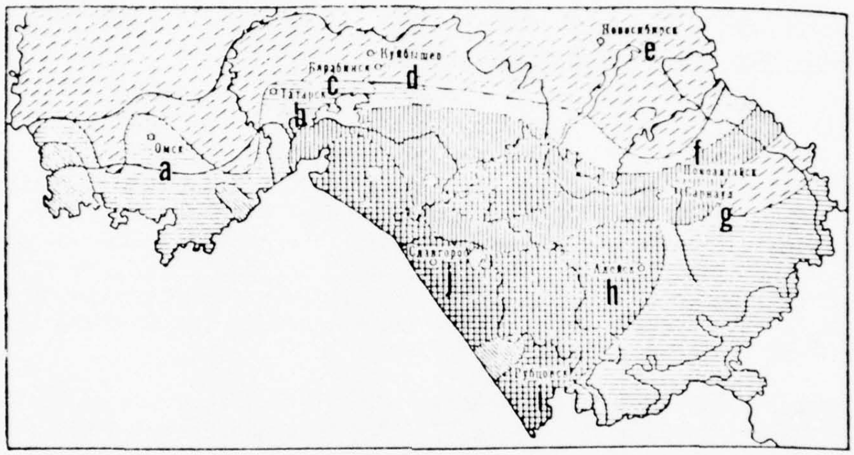
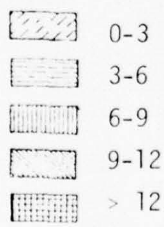


Figure 1. The number of days with dust storms in the steppe zone of western Siberia.



Key
a. Omsk
b. Tatarsk
c. Barabinsk
d. Kuybyshev
e. Novosibirsk
f. Novoaltaysk
g. Barnaul
h. Aleysk
i. Rubtsovsk
j. Slavgorod

TABLE 1

THE MEAN MULTIYEAR VALUES OF METEOROLOGICAL ELEMENTS WHICH ARE CHARACTERISTIC OF DUST STORMS

Series Order	Meteorological Station	No. of Dust Storms	Duration of Dust Storms (hours)	Mean Speed of the Wind for the Year (m/sec)	No. of Days With Strong Winds	Speed of the Wind During Dust Storms (m/sec)		Relative Humidity (%)	Air Temperature (°C)
						Mean	Maximum		
1	Omsk	11	32	4.9	19	6.4	16	40	20.4
2	Irtysh	19	82	4.2	-	8.2	24	-	-
3	Odesskoye	7	22	4.5	-	10.2	46	32	21.5
4	Kupino	11	21	5.1	36	10.5	28	29	22.6
5	Karasuk	15	41	4.8	34	10.5	20	32	23.1
6	Slavgorod	14	44	4.3	20	8.8	24	32	24.1
7	Rodina	18	41	4.5	16	9.7	20	31	26.4
8	Rubtsovsk	26	120	5.0	52	11.0	28	38	24.8
9	Volchikha	10	21	4.6	38	11.6	24	28	27.4
10	Aleysk	23	83	4.0	44	9.3	24	42	21.5

TABLE 2

NUMBER OF DUST STORMS
DURING THE PERIOD OF OBSERVATION

Station	1940-1954	1955-1966	1967-1969
Bayevo	6	11	14
Rebrikha	13	11	23
Khabary	4	8	10
Zav'yalovo	7	17	14
Slavgorod	11	19	7
Rodina	22	18	11
Klyuchi	16	20	15
Volchikha	12	10	5
Svedneye	11	14	12

The duration of dust storms can serve as a criterion of the intensity of the erosion process. The longer the dust storm, the more the soil is damaged. There exists an almost linear relationship between the number of dust storms in a year and their duration (in hours) in the year (Fig. 2). The correlation between these indicators is rather high (η = 0.93).

The most lengthy and intense dust storms are noted in the steppes and especially in the arid steppes (Fig. 3).

The duration of the individual dust storms is distinguished in relation to the type of synoptic conditions which determine the origins of the intensely stable or short-term winds.

Both short-period dust storms (up to 1.5 hours) and rather lengthy ones (3 to 6 hours) may occur with equal probability in Western Siberia. Their frequency of occurrence is very high and includes 11 to 40% of the general number of dust storms (Table 3). Dust storms occur less frequently (frequency of occurrence of 7 to 18%) with a duration from 1.5 to 3 hours.

The individual dust storms can be very lengthy (up to 24 hours and longer) and encompass significant territory. The dust storm of 28-29 April 1968 in Odessk and Kupino continued for 35 hours straight and spread over the entire area of the transitional and steppe zones of Western Siberia.

During the course of the year, dust storms are distributed most unevenly. The greatest danger for wind erosion occurs in the spring and early summer when the soil is pulverized in the process of preplanting and does not have the defenses lent by vegetation. Thus in May and June, 29 and 26% of the dust storms arise. In July, August, and September, the dust storms are less frequent (9-14%). Winter dust storms are comparatively rare although several investigators noted strong winter wind erosion in past years (Kremin, Kukis, 1967).

A very important characteristic of wind erosion of the soil is the critical speed of the wind which carries away particles of soil.

The critical speed, determined experimentally in wind tunnel, runs from 6-12 m/sec on an elevated anemometer. For the basic types of soil it is equal to 8-9 m/sec. The frequency of occurrence for winds with speeds of 8-9 m/sec is from 3.1 to 10.6% of the winds in a given year (Table 4).

With an increase in the frequency of occurrence of critical windspeeds, the number of days with dust storms increases. The relationship between these indicators is characterized by high correlation, 0.82 to 0.96. However, the speeds of the winds which are noted during dust storms vary within broad intervals (Table 5). Sometimes the dust storms occur at speeds of 2, 3, 4, and even 1 m/sec. These cases are not typical, denoting windspeeds during the transport of dust. Much more often the dust storms arise in winds

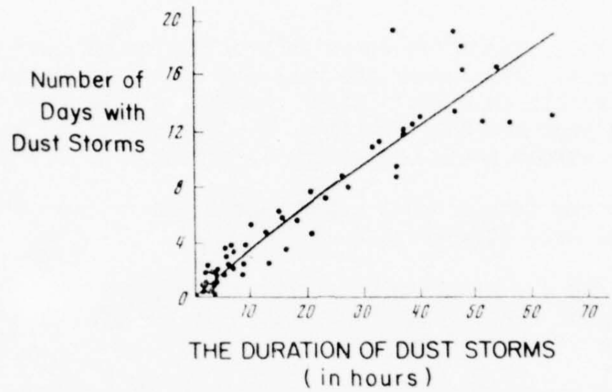


Figure 2. The relationship between the duration of dust storms (in hours) and the number of days with dust storms.

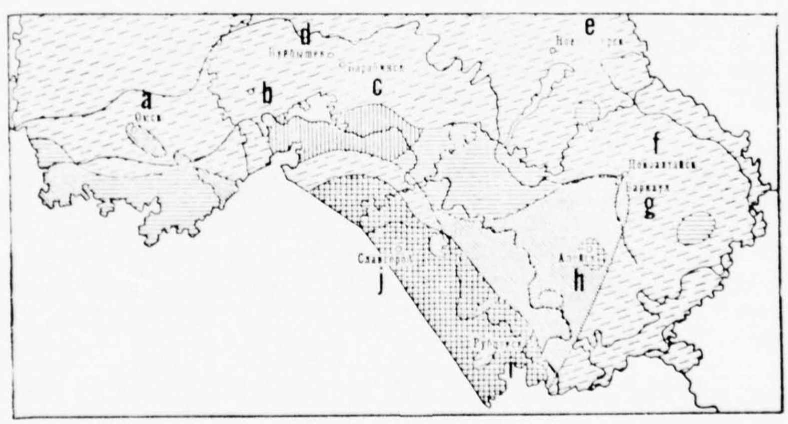


Figure 3. The duration of dust storms (in hours) in the steppe zone of western Siberia.

- 0-10
- 10-20
- 20-30
- 30-40
- > 40

Key:

a. Omsk	f. Novoaltaysk
b. Tatarsk	g. Barnaul
c. Barabinsk	h. Aleysk
d. Kuybyshev	i. Rubtovsk
e. Novosibirsk	j. Slavgorod

m. Chernigov B. Poltava
n. Kiev C. Khar'kov
o. Cherkassy D. Sumy

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TABLE 3

THE DURATION OF DUST STORMS
(%)

Station	Duration of Dust Storms (hours)					
	<0.5	0.5-1.5	1.5-3.0	3.1-5.0	6.1-9.0	>9
Omsk	18	40	16	20	4	2
Kupino	23	30	7	23	4	13
Karasuk	22	17	28	22	6	5
Slavgorod	24	26	18	24	8	-
Rodina	34	28	10	26	2	-
Rubtsovsk	16	39	7	32	6	-
Volchikha	39	39	11	11	-	-

TABLE 4

THE FREQUENCY OF VARIOUS WINDSPEEDS
(percent of total number in a year)

Station	Windspeed (m/sec)								
	0-1	2-3	4-5	6-7	8-9	10-13	14-17	18-20	>20
Barabinsk	8.0	23.7	26.1	16.6	10.6	11.5	3.1	0.4	0.02
Novosibirsk	31.2	28.5	20.1	11.6	4.4	2.8	1.1	0.3	0.02
Tatarsk	14.1	29.6	25.8	15.3	7.8	5.4	1.5	0.2	-
Zdvinsk	18.6	30.4	23.2	13.1	7.1	4.9	2.1	0.5	0.03
Kupino	21.4	24.8	20.1	12.4	8.2	8.2	4.0	0.8	0.03
Barnaul	35.6	27.8	17.8	8.4	3.4	3.9	2.2	0.7	0.2
Slavgorod	16.5	26.4	24.3	15.4	8.7	6.4	1.8	0.4	0.1
Biysk	28.8	35.6	20.2	8.6	3.1	2.2	1.2	0.3	0.03
Rodina	21.0	26.5	21.3	15.1	8.6	6.2	1.2	0.1	0.01

TABLE 5

THE FREQUENCY OF DUST STORMS (%)
FOR VARIOUS WINDSPEEDS (1940-70)

	Windspeed (m/sec)													
Station	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	23-24	25-26	>20
Kupino	3.1	8.1	8.4	13.3	15.2	22.6	7.4	1.8	17.7	1.8	-	0.3	-	0.3
Karasuk	1.1	6.6	12.7	17.7	23.8	19.2	4.3	1.8	9.4	3.4	-	-	-	-
Slavgorod	6.6	14.3	12.6	16.6	17.9	14.0	6.6	5.4	4.8	0.3	-	1.0	-	-
Rodina	4.9	9.7	12.2	19.7	25.5	15.1	3.8	4.4	3.3	1.3	-	-	-	-
Rubtsovsk	1.3	4.2	10.2	16.0	18.7	21.6	7.3	10.4	5.3	3.3	0.1	0.9	0.4	0.3
Volchikha	-	5.4	12.8	15.2	16.3	15.3	9.0	4.2	12.5	9.0	-	0.3	-	-
Aleysk	1.2	10.5	17.4	23.0	18.9	13.2	5.9	3.8	3.1	2.1	-	0.9	-	-

whose speed is in the range of critical speeds. The probability of maximal windspeed is of great interest (Table 6).

For the design of the intervals between tree belts, one might proceed from those windspeeds which might occur once during the entire period of amortization of the tree belt. Yet this is economically unprofitable. One ought to aim for a security rate of 20% (in the course of 5 years, the significant speeds will not occur more than once), all the more so since the significant windspeeds which may occur once in 5, 10, or 20 years, can fluctuate by 2 to 4 m/sec.

The number of days during the year with strong winds is obviously connected with the number of days with dust storms. During the period of active wind erosion of the soil (May-October), the relationship is weak: 0.36 ± 0.12. For the majority of the transitional and steppe zones of Western Siberia, 20 to 30 days with strong winds is the mean; but in the regions of Northern Kulunda Central Barab and in the north of the Priobsk Plateau, up to 40 days a year is the mean (Fig. 4).

Most often, dust storms occur during winds from a southwesterly direction, the frequency of occurrence of which is 10 to 52%.

CONCLUSIONS

1. The number of days with dust storms in Western Siberia ranges from an average of 0.2 to 34 a year. The greatest number of days with dust storms is noted in the steppes and arid steppes.

2. The duration of dust storms (in hours) for the year corresponds to the average yearly number of days with dust storms. The linkage between them is characterized by a high correlation coefficient - 0.93.

3. The average speed of the winds during dust storms is from 5.4 to 12.9, with a maximum from 11 to 46 m/sec.

4. In most parts of the transitional and steppe zones of Western Siberia, there are from 20 to 30 days a year with strong winds; but in the regions of Northern Kulund, Central Barab, and the north of the Priobsk Plateau, up to 40 days per year.

5. The critical speed for the start of wind erosion of the soil is 6 to 12 m/sec; for the basic kinds of soil, 8 to 9 m/sec. With an increased frequency of occurrence of critical windspeed, the number of days with dust storms is increased. The correlation is 0.82 to 0.96.

TABLE 6

THE MAXIMUM WINDSPEED PROBABILITY

Station	Windspeed (m/sec), Possible Once a Year				
	1 Year	5 Years	10 Years	15 Years	20 Years
Barabinsk	23	26	27	28	29
Tatarsk	20	23	24	25	26
Novosibirsk	20	23	24	25	26
Chisto-Ozernoye	23	26	28	29	30
Zdvinsk	20	23	24	25	26
Kupino	24	28	30	31	32
Karasuk	23	26	28	29	30
Rebrikha	21	24	26	26	27
Khabary	23	27	29	30	31
Barnaul	26	32	34	35	37
Slavgorod	24	28	30	31	32
Rodina	19	22	23	24	24
Aleysk	21	24	26	27	27
Rubtsovsk	25	29	31	32	33

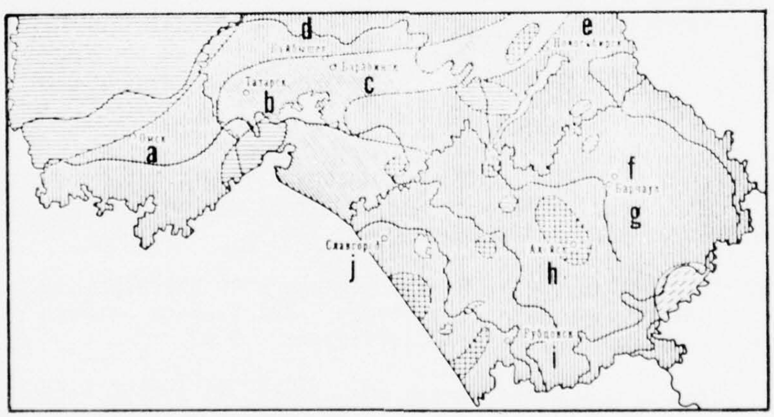

Figure 4. The number of days with strong wind ($\geq$ 15 m/sec) in the steppe zone of western Siberia.

- 0-10
- 10-20
- 20-30
- 30-40
- > 40

Key:
- a. Omsk
- b. Tatarsk
- c. Barabinsk
- d. Kuybyshev
- e. Novosibirsk
- f. Novoaltaysk
- g. Barnaul
- h. Aleysk
- i. Rubtsovsk
- j. Slavgorod

6. Dust storms most often arise during southwesterly winds, the frequency of occurrence of which is 10 to 52%.

7. The air temperature during dust storms fluctuates within broad limits: from 5° or 7°C to +35° or +40°C, the relative humidity from 10 to 75%.

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Kukis, S. I., 1968, "Dust Storms in the Altay Territory," Meteorol. Gidrol. (Moscow), No. 12, 74-79.

This article contains an investigation into the nature of dust storms in the Altay territory. Their quantitative indicators are given, including the distribution by months, by duration, the time of day at which they occur, and the different windspeeds. A number of conclusions are made characterizing dust storms and their tendency to occur in that region.

Until recently, wind erosion in the country and in the Altay territory in particular did not pose a serious threat, since it occurred, mainly, in the frame of a local, everyday occurrence. Only during bad droughts (1931, 1940, 1955), and also droughts which were repeated 2 to 3 years in succession (1951, 1952, 1953) or with a short interval (1962, 1963, 1965), did wind erosion spread over large territories, accompanied as a rule by dust storms.

Recently, since there has been a record growth of erosion in the steppe of the region, dust storms appear more often and are lasting longer. During winter, strong winds (not meeting obstacles in the treeless, open steppe) blow away the fine snow cover quite easily, leaving the soil bare and deeply frozen with a dry surface from which small fertile particles of soil are carried away in the form of dust. Winter and summer, thousands of tons of these particles are carried by dust storms into inhabited areas and cities of the region and even into the Gorno-Altay Autonomous District.

Dust (black) storms in the Altay region are a continuation of the increasing wind erosion and are its most active form, which destroys the soil. Hence, there is a requirement to perform an accurate and detailed study in determining dust storms and to develop an improved classification of dust storms, to provide a better method of studying the nature of this phenomenon which is so dangerous for the national economy.

Until now, there has been no generally accepted, clearly defined, single definition of a dust storm. In the current "Manual for Hydro-Meteorological Stations and Posts" (1958), a dust (sand) storm is characterized as the occurrence of a large amount of dust, sand, and particles of dry soil carried into the air by a strong wind, as a result of which the atmosphere becomes cloudy and visibility is considerably reduced. Dust storms are differentiated as weak (when visibility is from 2-10 km), medium (when visibility is from 1-2 km), and strong (when visibility is up to 1 km).

P. S. Zakharov gives a more suitable definition of the meaning of a dust storm for agriculture: "By dust storm one must understand the phenomenon, observed mainly in dry regions, when a strong wind destroys and blows away the top layer of soil. Agricultural crops can also be blown away with the soil. The amount of dust blown into the air considerably decreases visibility" [2].

There are other attempts to define a "dust storm." When classifying dust storms, G. G. Shemberg divides them into local (entopic) and of remote origin (exotic): I. N. Ostrovskiy into local, transit, and composite. T. S. Yakubov and several other authors have suggested classifications for them, but they do not reflect precisely the essence of this harmful phenomenon.

It must be noted that the occurrence of dust storms has only been slightly studied and the formulation of this research into the hydrometeorological service system does not answer current requirements.

The highest average long-term number of the dust storms in the steppe zone of the Altay region during the April-October period was observed in the Rubtsovsk area (more than 26 occurrences). There are large fluctuations in the number of dust storms in individual years. Hence, in the same area of Rubtsovsk, for 18 years the least number of dust storms was five, and the most was 91, in 1963.

Analysis of the data of distribution of the number of days with dust storms according to months of the warm period in areas of the Kulunda steppe shows that the greatest number of dust storms (27.6%) occurs in May and the second greatest number in June (22.2%); then there is a gradual reduction. This decrease can be explained by the increase in the amount of precipitation in the steppe during the second half of the summer and the appearance of a protective cover of growing cultivated plants and natural grass.

The nature of dust storms, their characteristics and tendencies in the steppe area of the Altay region have been studied by various authors. L. N. Gribanov [1], when investigating the nature of dust storms, had at his disposal data of nine meteorological stations in the Kulunda steppe (Fig. 1).

Table 1 compiled from these data, shows the average number of dust storms (in percent) for April-October 1939-1948, for the period preceding the development of virgin and fallow land. The maximum number of dust storms (60%) occurred in zones with dark chestnut-colored soil, the second greatest number (27%) in areas surrounding strips of pine forest with light sandy and sandy-loam soil and chernozem soil. These soils were least affected by dust storms (13%).

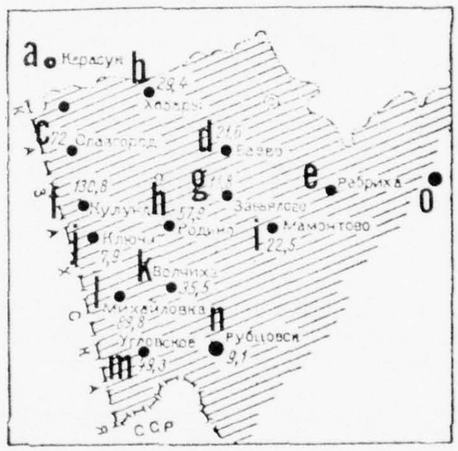

Figure 1. A diagrammatic map of the Altay region (without the Gorno-Altay Autonomous District). Shaded areas undergo wind erosion. The eroded area is shown by figures in thousands of hectares.

Key:				
	a.	Karasuk	i.	Mamontovo
	b.	Khabari	j.	Klyuchi
	c.	Slavgorod	k.	Volchikha
	d.	Bayevo	l.	Mikhaylovka
	e.	Rebrikha	m.	Uglovskoye
	f.	Kulunda	n.	Rubtsovsk
	g.	Zav'yalovo	o.	Kazakh
	h.	Rodno		

These detailed meteorological data on dust storms observed at the Kulunda Hydro-Meteorological Station (which is almost in the geometric center of the Altay region) for 1963-1966 [3] were studied and compared with data (which L. N. Gribanov showed, unfortunately, only in percent, without absolute indicators) on Klyuchi and Karasuk.

Table 2 shows the distribution of dust storms by months. Analysis of the data shows that over the past years dust storms have been observed during the whole year. The greatest number occurred in May (22%) and the second greatest number in June (13.3%). April (9.3%) and January (9.3%) are on the same level, and the least number occurred in February (1.8%). Months which previously had very few dust storms - January, November, December - are almost on the same level with April in recent years. If only the period for April-October is accepted in the Kulunda calculation (for comparison of data from Klyuchi and Karusuk), there is a significant shift in the number of dust storms for April and May at the expense of subsequent warm months.

Table 3 gives an idea of the frequency of the occurrence of dust storms at various times of the day. The table shows that the greatest number of dust storms occur between 1200 and 1500 hours (36.6%); many dust storms begin from 8 to 11 in the morning (31.1%); next are those storms which begin from 1600 to 1900 hours (21.2%); and the smallest number is observed from 2400 hours to 0700 hours in the morning (4.3%). In this respect, no significant changes have occurred over the past few years.

Great interest is being paid to information on the duration of dust storms (Table 4). From the data one can see that the main number of dust storms last from 1 to 3 hours (43.6%), storms with a duration of 4 to 7 hours comprise 25.5%; the remaining number last from 8 to 24 hours with a probability fluctuating in the ranges of 0.6 to 4.8%. The long duration of dust storms is significant. Few storms last for only up to half an hour, where before this figure was 30 to 40%. Storms have appeared which lasted for days.

For convenience, if we compare L. N. Gribanov's data and combine all the dust storms lasting 10 hours or more, over the past few years, the percentage of occurrence is 24, that is, one quarter. Previously, dust storms lasting 10 hours were not noticed and comprised only 1% of the dust storms.

Table 5 shows dust storms of various windspeeds. As a rule, when there is a windspeed of up to 5 m/sec (on the wind vane) dust storms do not occur. However, recently, one dust storm was noticed in July when the speed of the wind was even lower than 5 m/sec.

TABLE 1

DUST STORMS (%)

Bayevo	Slav- gorod	Klyuchi	Rebri- kha	Rodino	Kha- bari	Karasuk	Zav'ya- lovo	Volchi- kha	Total
6	12	18	12	8	6	22	1	15	100

TABLE 2

DISTRIBUTION OF DUST STORMS BY MONTHS

Months	Klyuchi (%)	Karasuk (%)	Kulunda No. of Occurrences	Kulunda Percent
January	-	-	15	9.3
February	-	-	3	1.8
March	-	-	4	2.5
April	9.1	9.3	15	9.3
May	24.7	20.5	36	22.0
June	27.3	23.2	22	13.3
July	10.4	13.7	14	8.7
August	11.1	17.1	9	5.6
September	13.0	12.6	11	6.8
October	4.4	3.6	6	3.7
November	-	-	14	8.6
December	-	-	12	7.4
Total	100	100	161	100

TABLE 3

FREQUENCY OF OCCURRENCES OF DUST STORMS
AT VARIOUS TIMES OF THE DAY

Hours From	Hours To	Klyuchi (%)	Karasuk (%)	Kulunda No. of Occurrences	Kulunda Percent
24	3	1	2	1	0.6
4	7	2	7	6	3.7
8	11	25	58	50	31.1
12	15	40	25	59	36.6
16	19	30	5	34	21.2
20	24	2	3	11	6.8
Total		100	100	161	100

TABLE 4

NUMBER AND DURATION OF DUST STORMS

Duration (hours)	Klyuchi (%)	Karasuk (%)	Kulunda Number of Occurrences	Kulunda Percent
0.5	30	40		0.6
1	15	13	37	23.0
2	14	14	15	9.4
3	13	9	18	11.2
4	7	4	9	5.6
5	7	8	10	6.2
6	6	5	13	8.1
7	3	3	9	5.6
8	3	2	6	3.8
9	1	1	4	2.5
10	1	1	8	4.8
11	-	-	1	0.6
12	-	-	1	0.6
13	-	-	1	0.6
14	-	-	1	0.6
15	-	-	1	0.6
16	-	-	3	1.8
17	-	-	3	1.8
18	-	-	1	0.6
19	-	-	7	4.5
20	-	-	3	1.8
21	-	-	1	0.6
22	-	-	1	0.6
23	-	-	-	-
24	-	-	7	4.5
Total	100	100	161	100

TABLE 5

THE NUMBER OF DUST STORMS OF VARIOUS WIND SPEEDS
(Numerator - per cent, Denominator - number of storms)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
							1-5 m/sec						
Karasuk	0	0	0	0	0	0	0	0	0	0	0	0	0
Klyuchi	0	0	0	0	0	0	0	0	0	0	0	0	0
Kulunda	0	0	0	0	0	0	7.1/1	0	0	0	0	0	0.6/1
							6-10 m/sec						
Karasuk	0	0	0	46	38	60	79	61	67	80	0	0	58.9
Klyuchi	0	0	0	13	16	41	19	41	0	14	0	0	24.8
Kulunda	0	0	33.3/1	13.3/2	21.6/8	18.1/4	35.7/5	44.4/4	36.3/4	33.3/2	14.3/2	0	19.7/32
							11-15 m/sec						
Karasuk	0	0	0		35	28	16	27	33	0	0	0	27.1
Klyuchi	0	0	0		52	46	75	47	60	43	0	0	51.0
Kulunda	26.6/4	100/3	66.7/2	46.7/7	27/10	45.5/10	35.7/5	22.2/2	0	0	35.7/5	58.3/7	34.0/55
							16-20 m/sec						
Karasuk	0	0	0	27	27	12	5	12	0	2	0	0	14.0
Klyuchi	0	0	0	47	32	13	6	12	40	43	0	0	23.5
Kulunda	73.4/11	0	0	33.3/5	35.2/13	22.7/5	21.5/3	22.2/2	63.7/7	66.7/4	35.7/5	25/3	36.4/59
							>20 m/sec						
Karasuk	0	0	0	0	0	0	0	0	0	0	0	0	0
Klyuchi	0	0	0	7	0	0	0	0	0	0	0	0	0.7
Kulunda	0	0	0	6.7/2	16.2/6	13.7/3	0	11.2/1	0	0	14.3/2	16.7/2	9.3/15

The greatest number of dust storms, 36.4% was registered with a windspeed of 16 to 20 m/sec, and 34% of the dust storms with a windspeed of 11 to 15 m/sec. Dust storms that occur with a speed of 6 to 10 m/sec comprise 19.7%, and 9.3% occur with a windspeed of greater than 20 m/sec.

On the basis of the data shown, 5 m/sec is the critical windspeed. In the Kulunda steppe, dust storms rarely occur at a windspeed of 5 m/sec. However, to protect the fields from dust storms, the windspeed must not exceed 5 m/sec. This can be done only by establishing a correct system of protective afforestation in the steppe areas of the region.

The shift in times of beginning and end of dust storms (Table 6) is also interesting. During 1963-1966, the earliest time was 4 January 1964. The latest period for the occurrence of dust storms was 29 December 1964. Therefore, they can appear throughout the year in the steppe area. The average indicators of duration of the period for the occurrence of dust storms, according to L. N. Gribanov, increased from 126 days at Karasuk and 143 days at Klyuchi to 249 days (Kulunda Hydro-Meteorological Station).

The following conclusions can be made from the analysis:

1. Dust storms at the present time occur each year on the steppe land of the Altay region.

2. The period when they occur has gone beyond the April-October limits (126-187) as was seen earlier (Gribanov, 1954) and now occur throughout the year.

3. The greatest number (35.3%) occurs in May and June, but many storms occur also in April, November, December, and January (7.4 to 9.3%).

4. The main number of storms begin in the period from 0800 until 1500 hours (67.7%) and their number increases toward midday.

5. The duration of dust storms has increased considerably. Thus, according to L. N. Gribanov, one-third of them lasted approximately 0.5 hour and 42% of all occurrences from 1 to 3 hours; according to data from recent years, dust storms lasting approximately 0.5 hour now only make up 0.6%, that is, they have decreased by 50 times the number for the period 1939 to 1948. The number of storms lasting from 1 to 3 hours has remained on the same level (43%); whereas dust storms lasting more than 10 hours, which were seldom registered, now make up 24%, and 4.5% of these last 24 hours.

6. Whereas earlier dust storms did not occur when there was a windspeed of up to 5 m/sec, over the past few years they have occurred, although singly.

TABLE 6

DATES OF FIRST AND LAST DUST STORMS

	Klyuchi			Karasuk				Kulunda		
Years	Beginning	End	No. of Days	Beginning	End	No. of Days	Years	Beginning	End	No. of Days
1939	29 Apr	21 Oct	176	28 Apr	21 Oct	177	1963	27 Feb	28 Dec	304
1940	18 Apr	2 Oct	168	13 Sep	30 Sep	171	1964	4 Jan	29 Dec	359
1941	28 Apr	4 Sep	130	15 May	16 Sep	124	1965	15 Mar	30 Nov	260
1942	9 May	17 Sep	132	8 Jun	18 Oct	103	1966	22 Apr	6 Jul	75
1943	24 May	7 Oct	137	16 May	1 Oct	138				
1944	21 Apr	23 Jun	64	12 Apr	17 Aug	128				
1945	2 May	3 Oct	155	26 May	13 Sep	111	Four-year average:			
1946	29 Apr	16 Sep	141	7 May	4 Aug	90				249
1947	8 Apr	7 Oct	187	18 May	7 Sep	113				
1948	26 Apr	17 Oct	175	26 May	3 Sep	111				
Ten-year average:			143			126				

The lack of indicators for absolute numbers of dry winds in the work by L. N. Gribanov does not allow one to analyze the increase in number of occurrences of dust storms in the steppe land of the Altay region which, according to our deep conviction, is taking place.

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The greater part of the territory of the Ukraine is distinguished by a favorable combination of soil-climatic conditions. Sunny, warm summers, a prolonged growing season, short winters, the fertile Ukrainian soil, all facilitate the development of a diversified agriculture and make it possible to obtain high yields of grain and industrial crops almost every year. However, the occurrence of drought and other unfavorable meteorological conditions limits the production of high and stable crop yields, unless definite agro-technical procedures are employed.

Dust storms - dangerous arid meteorological phenomena - rank first among those exceptionally unfavorable natural phenomena which have a destructive effect on agricultural production.

Very intense and destructive dust storms are rarely encountered. In the past century, they have been observed twice: in 1928 and in 1960. In the literature, we find descriptions of a severe dust storm in 1892.

The origin of dust storms is related to the stable development of dry atmospheric processes and their interaction with the underlying surface, the character of which facilitates the development and intensification of these phenomena. The processes which lead to the formation of drought conditions are varied and complex; a complex combination of a whole series of drought-formation processes takes place.

During a dust storm, the wind often gains in intensity sharply, up to 15 to 25 m/sec and more. The strong, gusty wind lifts masses of dust and sand into the air, tears away the top layer of soil and carries this burden of many tons for hundreds of kilometers. Crops are damaged by the wind, seeds and sprouts of plants are blown away, and dust smothers them or cuts them down. The relative humidity drops to its lowest level: 5 to 10%. Visibility deteriorates to 100 to 500 m, dust obscures the sun, and the normal rhythm of life is disrupted.

Dust storms in the Ukraine are very common. They are observed every year. Definite regularities are found in the distribution of dust storms across the territory of the Ukraine. The steppe zone is the most subject to dust storms, the forest-steppe and particularly the woodlands to a significantly lesser extent.

Dust storms appear often and are particularly intense in the spring, when winds in the steppe zone reach their greatest force and the soil over substantial areas has been loosened by cultivation and is bare of protective vegetative cover, particularly if the preceeding winter was low in snowfall and the spring dry and rainless.

The characteristics and frequency of dust storms provided in works published previously pertain to all dust storms, regardless of their intensity.

The dust storm is a complex composite natural phenomenon, whose most important characteristic, the wind, is one of the main factors in the process of dust storm development. Under the appropriate conditions, wind can effect an enormous amount of destruction. We may take windspeed as a first approximation for characterizing dust storm intensity, and classify those dust storms accompanied by wind of a speed exceeding 14 meters per second as the most intense.

The map (Fig. 1) gives a graphic presentation of the probabilities of dust storms with storm winds in the territory of the Ukraine. Three regions of high dust storm frequency stand out distinctly: the eastern steppe region, the great central region, including the steppe region of the Crimea, and the southwest region, which occupies the south of the Odessa region.

The greatest probability of intense dust storms is characteristic of the Lower Dnepr districts, amounting to five or six days per year (Nizhnie Serogozy - 4.8; Melitopol' - 5.3; Berislav - 5.9) and the northern Crimea (Klepinino - 7.1).

To the southwest and west of the territory under consideration, the number of dust storms with storm wind characteristics decreases almost everywhere, the number, on the average, being less than one. In the northeast Ukraine, instances of dust storms with storm winds are observed, at most, on 2 days each year.

In the steppe zone of the Ukraine, a significant number of dust storms (30%) are observed with storm winds. In an absolute majority of these instances, the winds have an easterly component (Table 1).

Eighty-eight percent of the intense dust storms are observed with easterly winds. Of these, 63% are due easterly, 22% are northeasterly and 3% are southeasterly. With westerly storm winds, intense dust storms arise only in 9% of the cases.

Table 1 allows us to draw yet another important conclusion: storm windspeed during dust storms amounts to 15 to 19 m/sec in 61% of the cases, 20 to 24 m/sec in 29% and 25 to 30 and over in 10%.

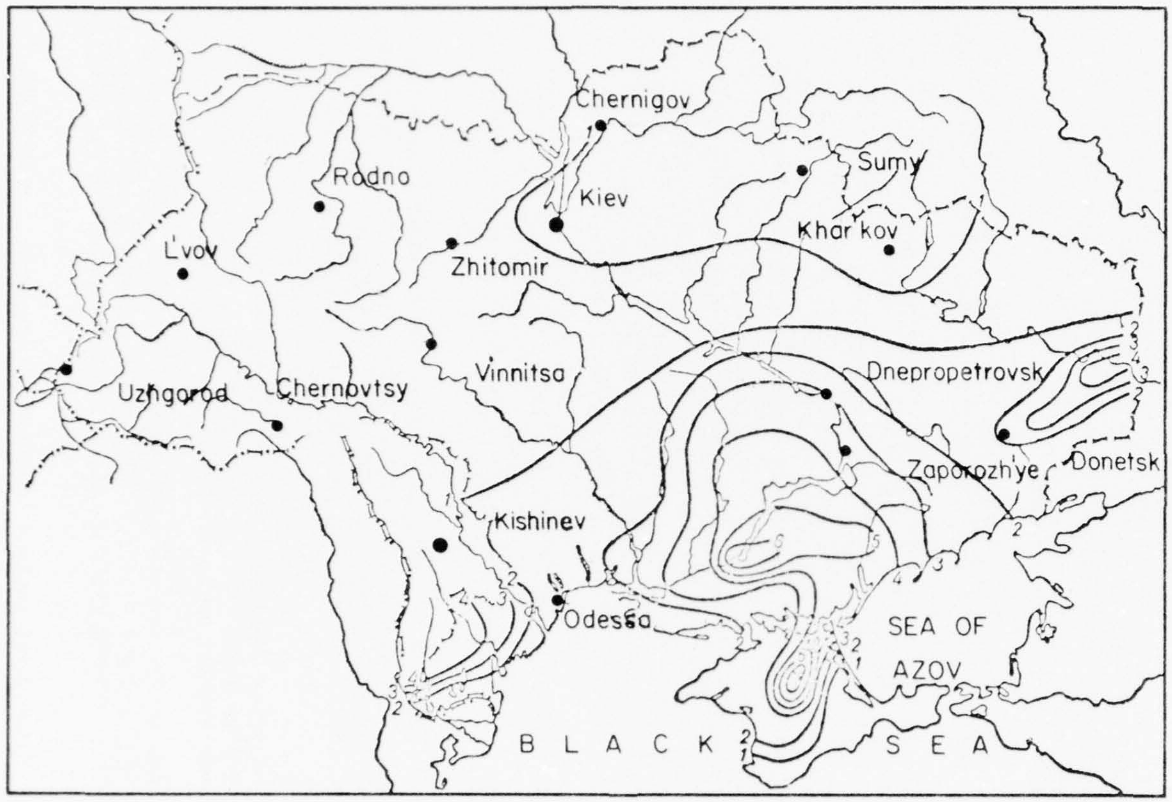

Figure 1. Frequency of intense dust storms in the Ukraine during the period 1945-1960 (days per year).

TABLE 1

FREQUENCY OF STRONG WINDS (>15 m/sec)
OF VARIOUS DIRECTIONS DURING DUST STORMS

	Wind Direction									
Speed (m/sec)	N	NE	E	SE	S	SW	W	NW	Total	Percent
15-19	-	25	70	5	6	5	2	9	122	61
20-24	-	17	39	1	1	1	-	-	59	29
25-30 and over	-	2	17	-	-	1	-	-	20	10
Total	-	44	126	6	7	7	2	9	201	100
Percent	-	22	63	3	3	3	1	5	100	-

It is important to note that dust storms in the woodlands and forest-steppe zone are very infrequent with windspeeds of 15 to 20 m/sec, and are never observed with speeds greater than 20 m/sec.

In a great part of the steppe zone of the Ukraine, dust storms accompanied by strong winds often occur. Thus, in the Krym, Odessa, Donetsk, Zaporozh'e, and Kherson regions up to 50% of the dust storms are connected with windspeeds greater than 15 m/sec. Particularly high windspeeds were reached during the dust storms of the spring of 1960. Many stations recorded windspeeds of 18 to 20 m/sec and higher. At Askaniya Nova wind gusts reached 28 to 34 m/sec, and the maximum speed, noted on 7 April, was 40 m/sec. At Veliko-Anadol' station the maximum speed noted was 24 to 28, with gusts up to 34 m/sec.

Such storm winds, which give rise to dust storms, are possible during the entire year (Table 2). They are most frequently observed in March, April, and the summer months. The minimum number of dust storms with storm winds is in January, since the overall probability of January dust storms is slight.

TABLE 2

NUMBER OF CASES OF DUST STORMS
WITH WINDS EXCEEDING 14 m/sec
(by month)

Station	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Askaniya Nova	-	-	13	17	5	-	2	2	3	2	-	-
Bashtanka	-	-	1	15	2	2	8	1	1	1	-	1
Volnovakha	-	1	4	12	-	-	3	1	3	-	-	2
Chernigov	-	-	1	-	4	5	3	1	2	-	-	-
Donetsk	2	3	5	7	3	5	10	4	1	2	3	-
Kirillovka	-	3	9	23	2	-	-	-	1	-	5	5
Klepinino	-	6	22	20	13	5	15	13	17	2	-	-
Kiev, city	-	-	1	2	5	9	4	-	4	-	-	-
Lutsk AMSG	-	-	-	2	2	2	1	3	1	-	-	-
Melitopol'	-	7	15	31	8	2	6	6	3	2	2	3
Nizhnie Serogozy	-	2	13	21	8	4	9	7	4	2	3	3
Simferopol'	-	2	16	14	1	-	-	2	-	-	-	-
Sumy AMSG	-	-	-	2	5	6	4	1	-	-	-	-
Kherson, agro	-	2	7	19	6	2	6	5	2	2	-	2

Sapozhnikova, S. A., 1970: Map Diagram of the Number of Days with Dust Storms in the Hot Zone of the USSR and the Adjacent Territories. Trudy Nauch.-Issled. Inst. Aeroklimatol. (Leningrad), No. 65, 61-68.

The study of dust storms has great practical importance for a number of branches of the national economy. The frequency of dust storms, as a typical unfavorable meteorological condition in general and an indirect indicator of wind erosion of soil in particular, presents an important interest.

In a desert zone, with its scanty vegetation, a dust (sand) storm may be considered a natural phenomenon characteristic of a desert landscape. In a steppe zone, this is almost always a consequence of insufficiently regulated land usage. However, in both zones, using modern technological capabilities, dust storms can be regulated.

At present, there are maps of dust storms for individual regions and zones of the country [1, 4-8], but apparently there is no overall map covering the entire territory of the USSR on which this phenomenon is noted.

The proposed map diagram (Fig. 1) can, to a certain degree, fill this gap. Designed to aid in answering questions connected with the operation and storing of technical goods and materials, it may possibly be also useful in devising a system for combating soil erosion. But it is mainly with regard to the first problem that the frequency of dust storms has been presented against a background of corresponding climatic regionalization [9], and includes the entire hot zone (with $T_{VII} > 25°C$) and adjacent parts of the moderate and cold zones.

Basically, the map is compiled from data from the Handbook [10], Part III (in the Ukraine Part V). The information on dust storms which is included in the Handbook was obtained from a number of observations not less than 8 to 9 years in the period from 1936 up to and including 1960-1964.

It should be noted that the frequency of dust storms in a significant portion of the territory in question, especially in regions where virgin soil was opened up, increased substantially after 1950. Therefore, a longer series of observations in certain instances are less representative of present conditions; they give relatively lower magnitudes. There is a basis for expecting that, until the implementation of measures to combat wind erosion, the probability of exceeding in individual years the number

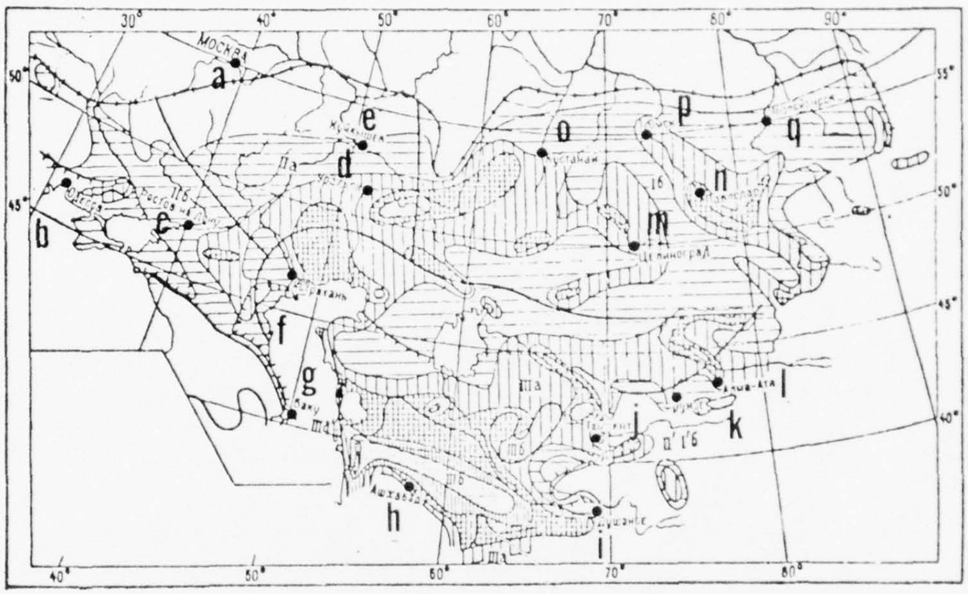

Figure 1. Number of days with dust storms.

boundary of the black-earth zone

boundary of the hot dry zone and regions

boundary of the area having reliable snow cover (dust storms are infrequent in such areas)

1-10 days

10-20 days

20-30 days

more than 30 days

more than 40 days

more than 60 days

more than 80 days

Climatic Regions:

IIIa -- hot dry
IIIb -- hot, moderately humid
IIIc -- very hot dry
Ic -- cold
IIa -- moderately cold
II' - I'c -- moderate and cold in mountains

Key:
a. Moscow
b. Odessa
c. Rostov-on-the-Don
d. Ural'sk
e. Kuybyshev
f. Astrakhan
g. Baku
h. Ashkhabad
i. Dushanbe
j. Tashkent
k. Frunze
l. Alma-Ata
m. Tselinograd
n. Pavlodar
o. Kustanay
p. Omsk
q. Novosibirsk

of days with dust storms, as presented on the map, will not equal 50%, as would be expected with an average value (with a distribution close to the normal), but 60% and more. The data from some stations in the Omsk Region[10] which are located near fields with loamy, easily eroded soils testify to the influence that the plowing of virgin lands has on the increase in frequency of dust storms.

TABLE 1

NUMBER OF DAYS WITH DUST STORM
(yearly average)

Station	1936-1950	1951-1962
Omsk, steppe	7	16
Isil'-Kul'	8	15
Pokrov-Irtyshsk	4	22
Poltavka	9	12
Cherlak	6	19

As can be seen from Table 1, at some stations the number of days with dust storms in the period 1951-1962 increased two, three, and even five times in comparison with 1936-1950.

In a number of regions adjacent to the hot zone, the Handbook has no data on dust storms. This circumstance made it difficult to determine the northwestern and northern boundary of dust storms (on the average of 1 day per year). In the European territory of the Soviet Union, the schematic boundary of the black-earth zone, which is apparently close to the boundary of the dust storms, was conditionally accepted as this boundary.

Considering the approximate nature of the data, in compiling the map large gradations of the number of days with dust storms were used for determining the isolines: 10 days (10, 20, 30) and even 20 days (40, 60, 80).

The territorial spread of dust storms, as can be seen from the map, is characterized by a spottedness. This, however, does not hide the zonal nature of their distribution. The number of dust storm days grows in a direction from the northwest to the southeast and reaches a maximum in Central Kara Kum. These last data agree well with the zonal distribution of vegetation. In the foothills, and especially in the mountains of Central Asia, the frequency of dust storms decreases sharply.

A relative assessment of climatic regions with respect to the frequency of dust storms is assisted by Table 2. The table shows the distribution of all stations found within the boundaries of the corresponding climatic regions, grouped according to the annual number of days with dust storms (in the Supplement these data are presented by Republics and Regions).

TABLE 2

DISTRIBUTION OF STATIONS ACCORDING TO THE AVERAGE YEARLY NUMBER OF DAYS WITH DUST STORMS (in %)

Climatic Regions	No. of Days Greater Than										No. of Stations
	1	5	10	20	30	40	50	60	80	100	
Very Hot, Dry	100	90	80	60	40	15	15	5			44
Hot, Dry	99	69	46	20	12	3	2	2	1	<1	161
Hot, Moderately Humid	100	50	0								4
Outside the Hot Zone											
Northern Regions of Kazakhstan	97	79	53	19	7	4	1				116

Considering the relatively equal territorial distribution of stations, the percent of stations with a certain number of dust storm days can be considered as an indicator which breaks down (in %) the territory of that given region with respect to the degree of frequency of dust storms. The very hot, dry region (III b) is characterized by the largest percent of territory with a significant frequency of dust storms. Here, for 40% of the territory, the mean yearly number of dust storm days exceeds 30, and for 15% of the territory, 50.

In the hot, dry region (III a) the percent of territory where the number of dust storm days equals 30 to 50 is two to three times less. But the highest frequency of dust storms (over 80 days) is found in this region: in Kurguzul (Turkmenistan), 81 days; in Takhiatash (Uzbekistan), 108 days. The first station is located on a sandy spit which divides the Kara-Bogaz-Gol Gulf from the Caspian Sea; here gale winds are often observed. The second station is located in the valley of the Syr-Darya, near easily-blown sands. Conditions analogous to Takhiatash and, consequently, a number of

dust storm days exceeding an average of 100 per year, are undoubtedly possible also in the very hot, dry region. At the same time, it must also be noted that in both regions, especially in the hot, dry one, there are stations where the average yearly number of dust storm days is less than 5.

In the northern regions of Kazakhstan, in the cold and moderate zones, the percent of territory with a high frequency of dust storms (>20 days) is less than in the hot zone. However, the number of dust storm days greater than 5 to 10 here embrace a slightly larger portion of the territory than in the hot zone. This can be explained by both natural and anthropogenic factors. These same factors are the reason for the spottedness in the spread of dust storms noted above.

From the natural azonal factors, it is first necessary to isolate sandy and loamy, easily-blown soils. Their territorial distribution within the boundary of a given zone can be considered incidental. According to the map of soil erosion [3], outside the hot zone the specific gravity of these soils is especially great in the northwestern part of Kazakhstan, where they aid the maximal development of dust storms in the north of the Aktyubinsk Region. These can explain the increased number of dust storm days along the Irtysh in the Pavlodar Region. But in both cases other factors also play an important role. Thus, the significant frequency of high winds aids the formation of the northwest dust storm maximum [2]. The influence of the plowing of virgin soil undoubtedly also contributes. Especially indicative in this respect is a comparison of agricultural regions with the so-called black earths of the Kalmyk and Dagestan ASSR, where, in cattle-grazing regions, the number of dust storm days does not exceed 10.

However, it is not just a matter of the plowing of virgin soil. An analysis of the map shows that there relatively narrow strips having increased numbers of days with dust storms stretching through the nonagricultural territory along railroads. This includes strips with gaps, firstly, along the main Central-Asian line (Bergochur, Chelkar, the Aral Sea, Kzyl-Orda and others) and, secondly, along the railroad from Karaganda to Karsakpay. Although there are sandy and loamy soils in the territory which the railroads cross, this alone does not lead to an increase in dust storms. The disruption of covering vegetation, including disruption by motor transport leading to the railroad outside of fixed spur tracks, also plays a definite role (in semi-desert plains and desert regions with light soils, travel is not limited to definite reads).

It must be especially underlined that even in this instance it is not a question of the agricultural opening up of territory, but of its mismanagement. This fact is indirectly supported by Table 3, where the number of dust storms in cities and in the territories immediately adjacent to

them is compared. In Table 3, as an example, is presented data from the Handbook [10] on pairs of stations having the same name. Where for each pair, one station is additionally marked as the urban one. In some cities, due to improvements, the number of days with dust storms has decreased more than half.

The decisive significance of anthropogenic factors affirms the possibility for the appearance of new dust storm centers within the boundaries of the territory under question, especially in its hot and dry regions.

The dust storm maximum occurs during the warm season. In more northern agricultural regions more frequent dust storms are observed at the beginning of the warm period, when, after the disappearance of the snow cover, the surface of the soil has dried up, but the vegetation has not yet developed and is unable to protect the soil from blowing. High windspeed in the spring (in comparison with the summer period) also have a definite significance.

TABLE 3

NUMBER OF DAYS WITH DUST STORMS INSIDE AND OUTSIDE CITIES

City	Inside City	Outside City
Guryev	19	27
Kzyl-Orda	29	37
Krasnovodsk	15	34
Tedzhen	29	54

In desert regions the dust storm maximum is reached in the central summer, drier months, when the ephemeral desert vegetation is completely burned up. In addition, at this time the summer minimum of windspeed is expressed less sharply here, and in the extreme south even gives way to a maximum.

In regions with an unstable snow cover (Fig. 1), dust storms are also possible in winter. The dust storms in January and February of 1969 are an example. The probability of dust storms increases linearly toward the south. The most frequent length of dust storms is up to 5 hours, but infrequently they can last up to 25 hours.

In conclusion, a knowledge of factors which determine the territorial distribution of dust storms and the change of these factors according to season is of great significance in taking measures to combat dust storms and the wind erosion of soils connected with them. Presently, our information in this area, especially quantitatively speaking, is very limited.

singly.

In addition, it is obvious that in the formation of dust storms an important role is played by local conditions. This is also shown by the spotted nature of the phenomenon's distribution.

One of the first tasks of the Central Administration of the Hydrometeorological Service (Gidrometsluzhby) must be a careful analysis of the location of each of the hydrometeorological stations. This must first include the extreme values of the frequency of dust storms (both large and small) so that the regularity of their formation can be clarified. Only after calculations based on these regularities is it possible to work out a rational, differentiated system of steps for combating this horrible phenomenon.

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SUPPLEMENT

DISTRIBUTION OF STATIONS (in %) ACCORDING
TO THE AVERAGE YEARLY NUMBER OF DUST STORMS

Republic, Region	No. of Days Greater Than										No. of Stations
	1	5	10	20	30	40	50	60	80	100	
In Republics of the Hot Zone Hot, Dry Region											
Kazakhstan	100	80	52	20	12	6	3				71
Uzbekistan	100	58	30	9	7					2	43
Turkmenistan	96	96	84	52	36	12	8	8	4		25
Tajikistan	100	28	14	9							22
Very Hot, Dry Region											
Uzbekistan	100	90	70	30	10						10
Turkmenistan		100	97	79	61	43	21	7			28
Tajikistan	100	50	33	33							6
In Regions of Kazakhstan Located Outside the Dry Zone											
Northern Kazakhstan	100	34	17								6
Kustanay	100	92	75	41	2						12
Kokchetav	100	83	33								6
Tselinograd	100	83	59	6							17
Pavlodar	100	89	55	11							9
Ural			100	59	34	17					12
Aktyubinsk	92	77	42	23	8	4	4				26
Karaganda	96	71	43	7	3	3					28

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Dust storms are observed at a number of points in Kazakhstan from April to October. They do considerable harm to pastoral livestock farming, cause soil erosion, and interfere with the normal work of aviation.

Dust storms occur under specific synoptic conditions in sandy areas (Karakum, Muyunkum, and Ret-Pak-Dala) and of pine-wood sand deserts. Dust storms are not very likely to occur from November to March at the majority of stations, with the exception of Kzyl-Orda and Dzhusala, where it is also possible for them to occur in these months.

The distribution of the number of days with dust storms throughout Kazakhstan over many years of observations is quite varied. Thus, for example, from 3 to 27 cases per year are observed at separate stations in Karaganda region, while from 6 to 26 cases per year are observed in Aktyubinsk region. It is characteristic that stations that differ strongly in the number of dust storms are often situated close to one another. The maximum possible number of days with dust storms in a year is presented in Figure 1.

Dust storms have a pronounced daily course with a maximum from 1300 to 1700 hours and a minimum in the early morning and late night hours. The average daily course of a number of cases of dust storms for 12 stations in Kazakhstan is presented in Figure 2. At Ural'sk, Aktyubinsk, Akmolinsk, Semipalatinsk, Atbasar, Karaganda, and Kustanay stations dust storms often begin at 1000 hours and end at about 2000 hours. However, a significant number of dust storms are observed from 0800 hours at Dzhusaly station. Dust storms are observed chiefly in the second half of the day at Alma-Ata station.

The duration of dust storms depends directly on their frequency. As can be seen from the data in Table 1, the greater the frequency of dust storms at a given station, the greater their duration.

In the majority of cases, dust storms are of short duration (15 - 45 minutes). A 6- to 7-hour duration of dust storms is possible at all stations in Kazakhstan, with the exception of Alma-Ata, where they are always of short duration. Dust storms of 10 to 12 hours duration are observed in Ural'sk, Aktyubinsk, Akmolinsk, Kustanay, Semipalatinsk, and in Atbasar. Dust storm durations of 15 hours and more were noted at Kazakhstan, Dzhambeyty, and Dzhusaly stations.

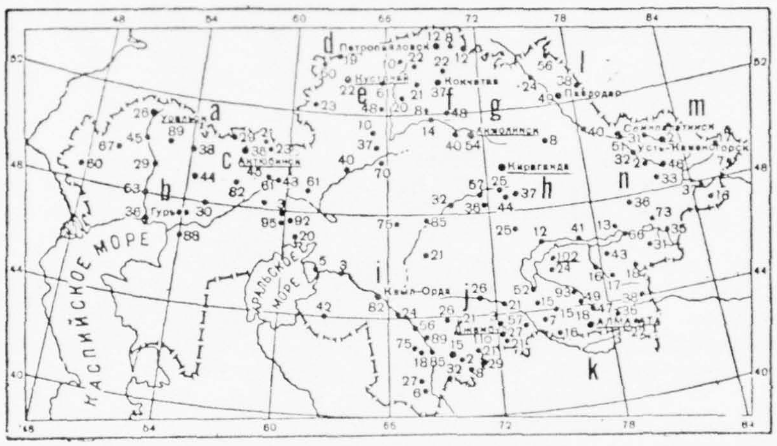

Figure 1. Maximum number of days with dust storms in a year.

Key:			
	a. Ural'sk	f. Kokchetav	k. Alma-Ata
	b. Gur'yev	g. Akmolinsk	l. Pavlodar
	c. Aktyubinsk	h. Karaganda	m. Semipalatinsk
	d. Petropavlovsk	i. Kzyl-Orda	n. Ust'-Kamenogorsk
	e. Kustanay	j. Dzhambul	

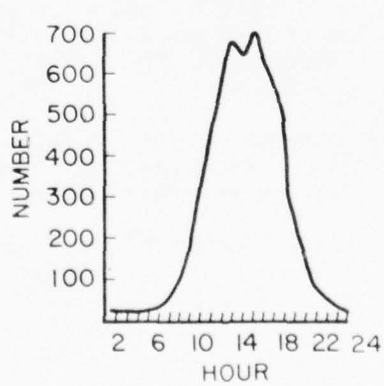

Figure 2. Daily course of dust storms in the period 1951-1955.

TABLE 1

FREQUENCY OF DUST STORMS OF VARYING DURATION
(number of cases in the period 1951-1955)

	Hours															
Station	Less Than 1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and More	Total Cases
Kazakhstan	38	28	29	32	17	21	27	27	15	17	14	3	10	3	2	4	287
Dzhanbeyty	19	14	26	25	31	21	24	14	22	19	9	10	5	3	1	5	248
Akmolinsk	47	29	12	15	12	13	12	8	4	5	2	4	1	-	1	-	165
Ural'sk	31	11	75	7	2	3	3	3	1	-	-	1	1	-	-	-	73
Zhana Semey	44	19	22	5	3	4	6	4	4	1	-	1	-	-	-	-	113
Dzhusaly	21	16	9	8	9	12	3	3	5	3	2	-	-	-	2	2	95
Kustanay	22	15	9	10	9	5	7	2	1	2	-	-	2	1	1	-	86
Aktyubinsk	25	15	13	8	2	1	2	4	-	2	1	1	-	-	-	-	74
Karaganda	31	19	13	5	1	5	1	4	-	-	-	-	-	-	-	-	79
Atbasar	12	5	2	3	3	5	1	3	-	-	-	1	-	1	-	-	36
Alma-Ata	44	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45
Chimkent	7	3	4	3	2	-	1	4	-	-	-	-	-	-	-	-	24

Since observations of windspeed and direction are not conducted immediately as a rule during dust storms, the wind in dust storms could be judged approximately according to data for the periods closest to the dust storm. These data are tabulated in Table 2. It follows from the data that in the majority of cases, no more than 3 hours before a dust storm (and sometimes even less), the windspeed is 7 to 10 m/sec, although winds of greater speed are undoubtedly observed during a dust storm (isolated annotations to Table TM-1 [meteorological table]).

The predominant wind directions in dust storms are in western regions of Kazakhstan - southerly, in the central and northern regions - northerly and westerly, and in the eastern regions - westerly (Table 2).

Dust storms usually occur when cold fronts pass through. As it has been noted in one work [5], as well as in [1,3,4], a forecast of this phenomenon amounts to a forecast of strong wind, taking into account the properties of the underlying surface.

From a synoptic point of view, it is necessary to distinguish frontal dust storms and the dust storms of storm zones. The authors have established two more kinds of synoptic conditions in which dust storms are noted at a number of stations in Kazakhstan. First, dust storms develop at the peripheries of high barometric pressure areas. Second, they are observed when very slow moving fronts associated with an intense low pressure system situated considerably to the north of the region of occurrence of dust storms pass through. Occurrence of small orographic waves and local dust storms are possible on such fronts when they approach a mountainous region. In this case, dust storms occur not only along the cold front but also frequently along the warm front, as well as in the warm sector of the low pressure area.

A condition for the occurrence of local dust storms is thermal turbulence caused by slow moving fronts situated, on the synoptic map, in a deformation field above which there is a sharply pronounced upper frontal zone with strong winds (Fig. 3).

Dust storms are often observed on the periphery of intense high pressure areas (Fig. 4). The location of such anticylcones determines the region of occurrence of dust storms. Thus, e.g., if an anticyclone is situated above the middle reaches of the river Obi, dust storms occur in the regions of Kustanay, Akmolinsk, Semipalatinsk, and Pavlodar regions.

Two to four days pass from the moment of formation of high stationary anticyclone to the beginning of its breakdown. During this time dust storms are often observed during daytime hours at the same point (or sometimes at neighboring points) on the periphery of the intense high pressure area where up to great altitudes (3 to 5 km) the winds do not change direction or turn, with altitude, at a very small angle. Surface

TABLE 2

WIND DIRECTION AND SPEED AT PERIODS CLOSEST TO A DUST STORM
(number of cases in the period 1951-1955)

Station	N	N-NE	NE	E-NE	E	E-SE	SE	S-SE	S	S-SW
Ural'sk	10	6	6	7	-	1	4	3	14	7
Kazakhstan	17	16	9	13	12	15	17	21	18	15
Dzhambeyty	9	23	13	17	8	12	20	14	29	16
Kalmykovo	3	3	6	6	4	5	9	13	6	6
Aktyubinsk	-	3	7	3	5	3	11	1	8	5
Kustanay	4	8	9	2	3	2	4	2	9	3
Dzhusaly	15	10	19	16	12	2	-	3	1	-
Akmolinsk	6	23	20	22	7	8	4	6	6	23
Karaganda	8	2	9	4	5	-	5	4	2	3
Semipalatinsk	9	11	7	1	1	-	4	2	4	4
Alma-Ata	5	-	1	1	3	-	2	-	7	1

Station	SW	W-SW	W	W-NW	NW	N-NW	Total Cases	Windspeed (m/sec) 1-3	4-6	7-10	11-14	15-20	>20
Ural'sk	6	5	5	-	3	2	79	4	9	29	18	19	-
Kazakhstan	27	19	12	12	24	17	265	11	55	122	41	36	-
Dzhambeyty	22	13	8	9	15	20	248	11	25	95	95	20	2
Kalmykovo	9	4	-	3	4	7	88	3	12	49	18	6	-
Aktyubinsk	7	7	5	1	7	6	79	6	12	22	21	19	-
Kustanay	16	9	2	4	4	3	84	3	13	41	23	4	-
Dzhusaly	4	5	6	8	13	7	121	1	7	17	43	53	-
Akmolinsk	15	14	10	10	3	10	165	8	39	85	44	9	2
Karaganda	15	6	11	2	2	2	80	5	12	21	23	18	1
Semipalatinsk	11	9	15	7	13	7	105	10	27	43	15	11	-
Alma-Ata	10	2	6	-	4	-	42	19	18	3	1	1	-

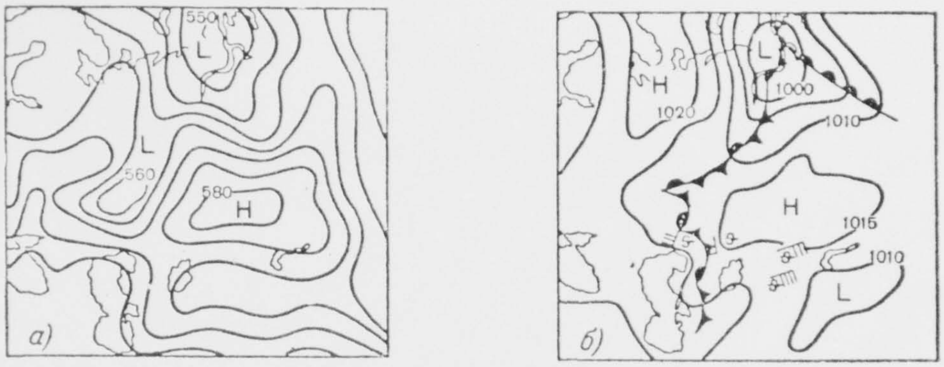

Figure 3. The synoptic situation in a dust storm at Ural'sk, Aktyubinsk, Dzhezkazgan, and Dzhusaly stations, 19 May 1955.

Key: a. Chart of barometric topography--1700 hours.
b. Surface chart--1500 hours.

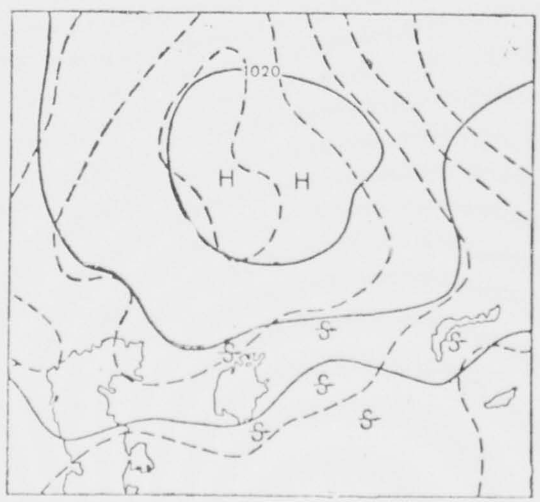

Figure 4. Dust storms in a high anticyclone at the Ayak-Kum, Kzyl-Orda, southern bank of the Balkhash, Chimbay, and Chiili stations, 1500 hours, 24 August 1957.

barometric gradients may also be small (4 to 5 mbar per 100 km), but in daytime heating and development of thermal turbulence, windspeeds increase and do not correspond to the gradients on the ground. Downward transfer of relatively high windspeed in this case is facilitated by vertical atmospheric instability, which is observed on the periphery of the anticyclone. Vertical temperature gradients according to morning sounding balloons up to altitudes of 0.5 to 1.0 km are usually small or even negative, while from an altitude of 1 to 2 km, they increase sharply to greater than moist-adiabatic values. In daytime hours the instability increases, embracing the lower levels.

In forecasting dust storms, it is very important to follow the stages of an anticyclone's development. As soon as signs appear that the anticyclone is becoming intense, there is a basis for expecting the wind to increase (during the daytime hours) for 2 to 3 days on its southern and eastern peripheries at a distance of about 500 to 600 km from the center.

Dust storms also occur on the southern and southeastern periphery of an intense cyclone in a zone of secondary fronts near the ground that already exist in diffuse form.

Dust storms on such fronts are of short duration and occur - as in the case of anticyclones - when isobars near the ground and isohypses at the 500 to 700 mbar level become parallel (i.e., when winds in a section do not change direction with altitude).

Vertical temperature gradients and barometric gradients near the ground have the same peculiarities as in intense anticyclones. An example of dust storms on the periphery of an intense low pressure area is presented in Figure 5.

In order to forecast the place where dust storms will occur on the periphery of intense low and high pressure areas, it is naturally necessary to know their future geographic position. Thus, the position of an intense, cold low pressure area may be determined with sufficient certainty according to the method of T. A. Duletova and M. Kh. Baydal [3,4].

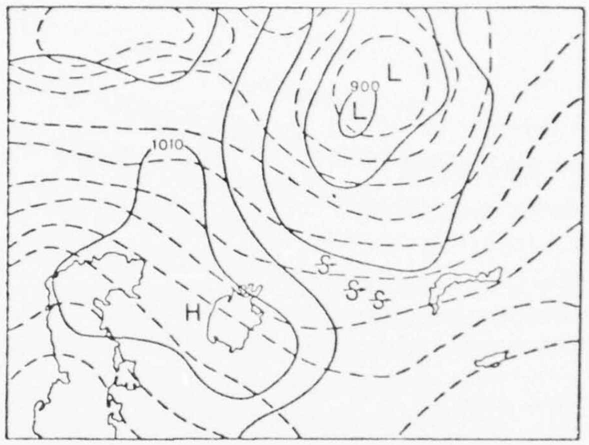

Figure 5. Dust storms in a high cyclone at Bet Pak Dala, Dzhetykonur, and Karsakpay stations, 1500 hours, 4 August 1957.

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Dust, or black, storms are observed fairly frequently in dry regions and do considerable damage to agriculture.

In the "Instructions for Hydrometeorological Stations and Posts" (1956), dust storms are called "a phenomenon in which during a strong wind much dust, sand and particles of dry earth are lifted into the air, as a result of which there occurs turbidity in the atmosphere and a significant decrease in visibility." Using this definition, meteorological stations record dust storms on the basis of two factors - the presence of a strong wind and dustiness in the atmosphere. Therefore, turbidity of the atmosphere caused by dust carried by the wind from afar is often attributed to a dust storm; defining a dust storm is made more difficult by the lack of any kind of quantitative criteria.

In connection with the significant damage caused by dust storms, a necessity for defining the phenomenon more fully in agricultural meteorology has arisen. Apparently, in the basic definition of a dust storm, it is necessary to assume three characteristics: the presence of a strong wind, disturbance and erosion of soil (young crops), and a significant decrease in visibility.

By dust storm we understand a natural phenomenon observed in dry regions during which a strong wind with speed of more than 15 m/sec erodes the upper layer of the soil. Along with soil, sometimes, new agricultural crops are blown off, a mass of dust is lifted into the air, and the result is that visibility is significantly decreased.

During dust storms, often all of the arable layer is blown off along with seeds and young vegetation not mature enough to anchor the soil, while the firmly rooted vegetation is cut by the particles of fine earth carried in the air or is covered over by the dust. During dust storms, the root system of the vegetation is laid bare, the soil is dried out, and transpiration of the vegetation is increased. All of this destroys the normal supply of moisture to the vegetation and causes a decrease in the harvest. The dust carried up into the air settles in areas where the windspeed drops because of the effect of various obstacles. At buildings, fences, in wooded areas, and highway ditches, earth embankments form, in some cases reaching considerable size. Because of dust storms, planning the conduct of agriculture is disturbed; the time period for sowing is disrupted; and during reseeding, more valuable crops are frequently replaced with less valuable ones.

The greatest harm which is done by dust storms is not the direct damage from them, but the loss of fertile soils as a result of erosion of fine soil and nutritive substances from the upper, most fertile, humus layer.

Properly speaking, one must distinguish dust storms from advective dust storms which occur as a result of the transfer of dust by the wind to a region beyond the boundaries of soil erosion. S. G. Popruzhenko (1893), G. G. Shenberg (1915), and others called these storms "dust fogs." The advective storms are characterized by heavy impregnation of the air with a fine-grain, as a result of which visibility is decreased. During this type of storm, in the regions where they are observed, erosion of the soil and new plantings do not occur. The windspeed during advective storms can vary, but usually is below 15 m/sec. The damage caused by them to agriculture is less noticeable - it results in partial cutting and burying of vegetation and in an increase of dry wind if these phenomena coincide as a result of an increase in the temperature of the air from the dry and heated dust.

Dust storms are distributed in the forest steppe, the steppe and semi-desert zones. Inasmuch as the greatest damage they do is to agricultural regions of the country (where more than 100 million hectares of arable land are located), we will consider their distribution in these regions. We will not consider regions with blowing sand (desert and partially semidesert zones).

In reference to climate, this broad territory is characterized by a dry and continental climate, and moreover, the dryness and continentality of the climate increases from the northwest to the southeast and south.

Among the peculiarities of climate which cause dust storms, the wind pattern is very important. The average annual windspeed in the steppe zone of the European part of the USSR varies between 4 to 6 m/sec and in the northern regions of Kazakhstan, from 4.5 to 5 m/sec. According to the data of L. Ye. Anapol'skaya (1961), winds with speed from 2 to 10 m/sec occur most frequently - 72 percent of the year; the frequency of winds with speeds of 11 to 15 m/sec - 7 percent and winds with a speed of more than 15 m/sec occur even less frequently - 1 to 3 percent. A wind with a speed of 24 to 25 m/sec is possible once a year.

The maximum windspeeds in the southern part of the European territory of the USSR are observed from February to April, and in northern Kazakhstan and southwestern Siberia, they are observed also in the fall. The minimum windspeeds occur in the summer.

Strong winds with a speed of more than 15 m/sec in the steppes of the European part of the USSR - in all seasons of the year - have an easterly direction; in western Siberia and Kazakhstan, southerly, southwesterly, and westerly winds prevail.

On a yearly average in the steppe region of the Ukraine and the northern Caucusus, a strong wind blows from 20 to 48 days, in the Volga region from 14 to 25 days, and northern Kazakhstan from 10 to 60 days. Data on the frequency of strong winds show the possibility of dust storms occurring in these regions when the condition of the underlying surface is suitable. Exceptionally favorable conditions for soil erosion occur in large plowed areas devoid of a vegetation covering, with low moisture content in the soil. Such conditions in an agricultural zone often occur in spring and fall-winter periods. In the Ukraine and northern Caucusus, approximately 65 to 70 percent of the dust storms occur in the spring, in northern Kazakhstan 40 to 50 percent, and in the Altai Territory (Kulundinsk Steppe) 45 to 60 percent.

By analyzing the data of meteorological stations for many years and the materials obtained by the distribution of special forms in agricultural publications, we have compiled a map of the frequency of dust storms for the agricultural zone of the Soviet Union (Fig. 1).

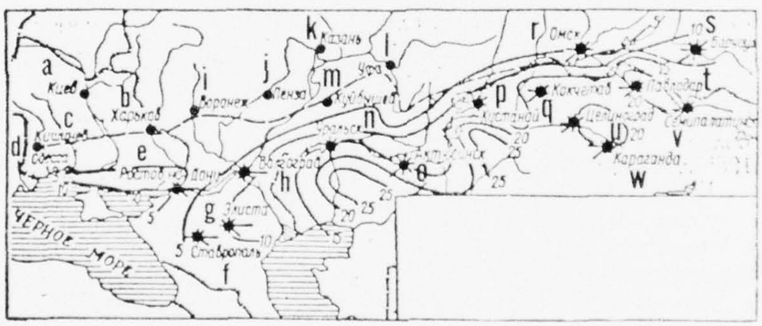

Figure 1. Frequency of dust storms for the agricultural zone of the Soviet Union.

--- Northern boundary of greatest distribution of dust storms, according to the data of S. S. Sobolev and others (1955).

—— The average number of days with dust storms per year.

✱ Wind roses during dust storms or periods before and after.

Key:

a. Kiev
b. Khar'kov
c. Kishinev
d. Odessa
e. Rostov-on-the-Don
f. Stavropol'
g. Elista
h. Volgograd
i. Voronezh
j. Penza
k. Kazan
l. Ufa
m. Kuybyshev
n. Ural'sk
o. Aktyubinsk
p. Kustanay
q. Kokchetav
r. Omsk
s. Barnaul
t. Pavlodar
u. Tselinograd
v. Semipalatinsk
w. Karaganda

On the map, the regions of the greatest development of dust storms is very clear: all of them are located in Kazakhstan, mainly in the Tselina Kray (territory) and involve regions with the greatest plowing of virgin and long-fallow land. The maximum average annual number of days with dust storms is in the Tselinograd (Karagand region). In certain years, there were from 50 to 60 days of dust storms.

The second region with more than 20 dust storms is located south of Kustanay; it includes the Turgay plateau. A significant number of dust storms (20 per year) is observed in the Kokchetav province and east of Irtysh, in the Pavlodar province. These regions on the map are marked with closed isolines. The maximum number of dust storms per year is 37 in Kokchetav and 49 in Pavlodar. Many dust storms occur in the Aktyubinsk, Gur'yev and the Ural'sk provinces. There are records of some years when there were 26 days with dust storms in Ural'sk, 35 days in Aktyubinsk, and 36 days in Gur'yev. To the north and west of the regions noted, the number of dust storms decreases.

The frequency of dust storms in the southern European part of the USSR does not exceed 10 days, on the average. However, in unfavorable years, dust storms occur more frequently and their number increases to 20 to 30.

An isoline corresponding to 5 days with storms passes through the European part of the Soviet Union along the lower course of the Dnieper to Zaporozh'ye, and further to the east to Rostov-on-the-Don where it is interrupted. Further, an isoline begins at Armavir, goes to the north (to the Tsimlyansk Sea), then to Volgograd (Chapayevsk), and passes along to the southwestern region of the Bashkir ASSR and the Transural. From there the isoline goes north to the southern and eastern regions of the Chelyabinsk province. It goes to the south of the Novosibirsk province through the southern forest steppe of the Omsk province. Our data specify the boundaries of the greatest distribution of dust storms established in 1955 by S. S. Sobolev, I. F. Sdobnikov, and others.

The prevailing direction of winds during dust storms varies. In Kazakhstan, the dust storms frequently occur when there are westerly and southwesterly winds and in the European section of the USSR when there are easterly winds.

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AD-A040 581 ARMY ELECTRONICS COMMAND WHITE SANDS MISSILE RANGE N--ETC F/G 4/1
BOUNDARY LAYER DUST OCCURRENCE, III, ATMOSPHERIC DUST OVER RUSS--ETC(U)
MAY 77 B D HINDS, G B HOIDALE

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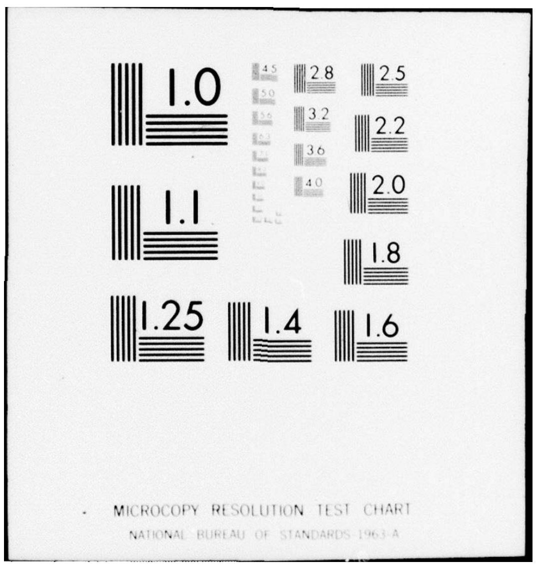
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5.0
5.6
2.8
3.2
3.6
4.0
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2.0
1.1
1.8
1.25
1.4
1.6
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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